

Appendix B. Description of the Analysis Process

Introduction

This appendix summarizes the various analyses used to assess the environmental effects of the proposed revised plan and its alternatives as described in the main body of the draft environmental impact statement (DEIS). The basic analytical framework and process for revising land management plans is prescribed by the 1982 Planning Rule Provisions (Sec. 219.12).

During the plan revision process, a set of alternative scenarios was developed to compare and contrast the proposed revised plan and its alternatives in terms of their ability to achieve desired conditions (DCs).

Eight general assumptions were common to all analyses:

- Land management plan alternatives provide programmatic frameworks for future site-specific actions.
- Land management plan alternatives do not have direct effects. They do not authorize or mandate any site-specific projects or activities (including ground-disturbing actions).
- Land management plan alternatives may have implications for, or longer term environmental consequences from, management on the Prescott NF under these programmatic frameworks.
- Law, policy, and regulations will be followed when planning or implementing site-specific projects and activities of a proposed alternative including implementation of best management practices as required by the Environmental Protection Agency and the Arizona Department of Environmental Quality.
- The plan decisions (i.e., desired conditions, objectives, standards, guidelines, management areas, suitability, monitoring) of a proposed alternative will be followed when planning or implementing site-specific projects and activities.
- Monitoring will occur to inform future land management decisions.
- Management activities that help ecosystems accommodate changes adaptively will improve ecosystem resiliency in the long term.
- The planning timeframe is 10 years; other timeframes may be analyzed to compare anticipated trends into the future.

The analysis of effects included the evaluation of potential wilderness and research natural areas; the eligibility of rivers for wild and scenic designation; the determination of suitability for recreation opportunities, livestock grazing, and timber production; the evaluation of movement toward vegetation and watershed desired conditions; the determination of species viability, the selection of management indicator species (MIS); the evaluation of movement toward desired conditions for recreation, scenery, and open space; and social and economic impacts. These analyses are further described in the sections that follow.

Evaluation of Potential Wilderness Areas

The National Forest Management Act (NFMA) (P.L. 94-588) requires that all areas meeting minimum criteria as wilderness (i.e., roadless and undeveloped) be considered for recommendation for wilderness designation during plan revision. Recommended areas are those

which are capable of providing wilderness experiences and character, are available for recommendation in comparison to other values that exist in the area, and respond to the need for additional wilderness in the National Wilderness Preservation System.

The wilderness evaluation followed the process as outlined in Forest Service Handbook 1909.12, Chapter 70. This process consists of three steps: (1) identification of potential areas, (2) evaluation of potential areas, and (3) recommendation of potential areas.

Identification of Potential Areas

The minimum criteria for potential wilderness areas (PWAs) include:

- The area must be at least 5,000 acres in size or meet at least one of the following conditions:
 - o Can be preserved due to physical terrain and natural conditions.
 - o Self-contained ecosystems, such as an island, that can be effectively managed as a separate unit of the National Wilderness Preservation System.
 - o Adjacent to existing wilderness, primitive areas, Administration-endorsed wilderness, or potential wilderness in other Federal ownership, regardless of their size.
- The area must not contain forest roads (36 CFR 212.1) or other permanently authorized roads.

Twenty-nine areas were determined to meet these conditions. One area identified in the inventory, Hackberry PW-03-09-017, was not carried forward in the evaluation process on the Prescott National Forest because it is adjacent to the Hackberry PW-03-04-026 area on the Coconino National Forest and was included in their potential wilderness evaluation. Sycamore Canyon C PW-03-09-027 spans the boundary between the Prescott National Forest and Kaibab National Forest. The entire parcel was analyzed by the Prescott National Forest in this evaluation.

Evaluation of Potential Areas

The capability of an area as wilderness was identified using a scoring process specific to the Prescott NF that covered 15 criteria developed by the Southwestern Region Regional Office. As the PWAs were assessed, they were assigned a high, medium, or low rating based on a points system for each criterion. The overall capability rating for a PWA was based on the total number of points earned. A score of 50 or higher was needed to achieve an overall rating of high. Medium scores were between 43 and 49 points. Potential wilderness areas that had a low score, less than 43 out of 57 possible points, were determined to have insufficient wilderness character.

Eight of the 28 PWAs were not considered for further evaluation because they scored below the 43 point threshold needed to proceed to the availability and need assessments. All of the PWAs that scored more than 43 points were analyzed for both availability and need—there were no further eliminations during those stages of the process.

The evaluation of an area's availability as wilderness included a consideration for the opportunity/cost of wilderness recommendation to other resource uses in that area such as timber production, grazing, or mineral production.

The need for the area as wilderness was analyzed on a regional basis. Consideration was given to size, setting, location of existing wilderness, and unconfined recreation opportunities provided. Preference was given to landforms and ecosystems that are underrepresented in the region.

The potential effects of both wilderness designated and management as nonwilderness were documented for each area. Factors examined included the effects to the area's wilderness characteristics and values; the effects to other resources such as recreation, wildlife, and timber; and the economic and social effects.

Recommendation of Potential Wilderness Areas

Eight areas were recommended for wilderness designation in the proposed revised plan (alternative B). Alternatives A and C did not recommend any potential wilderness areas for designation, and alternative D recommended 16 potential wilderness areas (table 1 and figures 3 through 4).

Table 1. Potential Wilderness Evaluation

| | |
|--|----|
| Potential wilderness areas identified | 29 |
| Potential wilderness areas evaluated | 28 |
| Potential wilderness areas containing basic wilderness characteristics | 20 |
| Potential wilderness areas recommended for wilderness designation | |
| Alternatives A and C | 0 |
| Alternative B | 8 |
| Alternative D | 16 |

The focus of alternative D is to increase the quantity and diversity of recreation opportunities on the Prescott NF, and the expansion of the wilderness base in alternative D does not come at the expense of any existing motorized recreation opportunities. Four potential wilderness areas were not recommended in this alternative for the following reasons:

Bald Mountain – Bald Mountain PWA currently contains about one and a half miles of motorized trail. Wilderness designation would require that this trail be closed to motorized use, thus representing an actual, not potential, loss of a motorized recreational opportunity.

Black Canyon – Wilderness designation for the Black Canyon PWA would preclude future development of mountain biking opportunities in a prime area adjacent to the towns and communities within Verde Valley.

Fritsche A – Wilderness designation for the Fritsche A PWA would limit future development of motorized recreation opportunities in the vicinity of the Paulden community. Current use includes off-highway vehicle use on area trails and for hunting access.

Pine Mountain A – Wilderness designation for the Pine Mountain A PWA, in conjunction with wilderness designation for Pine Mountain C, would result in

private property being surrounded by wilderness. The existing private property and access road occurs within the boundaries for Pine Mountain A; therefore, it would be better to designate Pine Mountain C, north of Forest Road 68, and maintain Forest Road 68 for access to the area.

Documents that provide additional details on the potential wilderness evaluation:

- Prescott National Forest Potential Wilderness Area Evaluation Report (Forest Service, 2011a)
- Wilderness Recommendations by Forest Plan Alternative (Forest Service, 2011b)
- Forest Service Handbook 1919.12

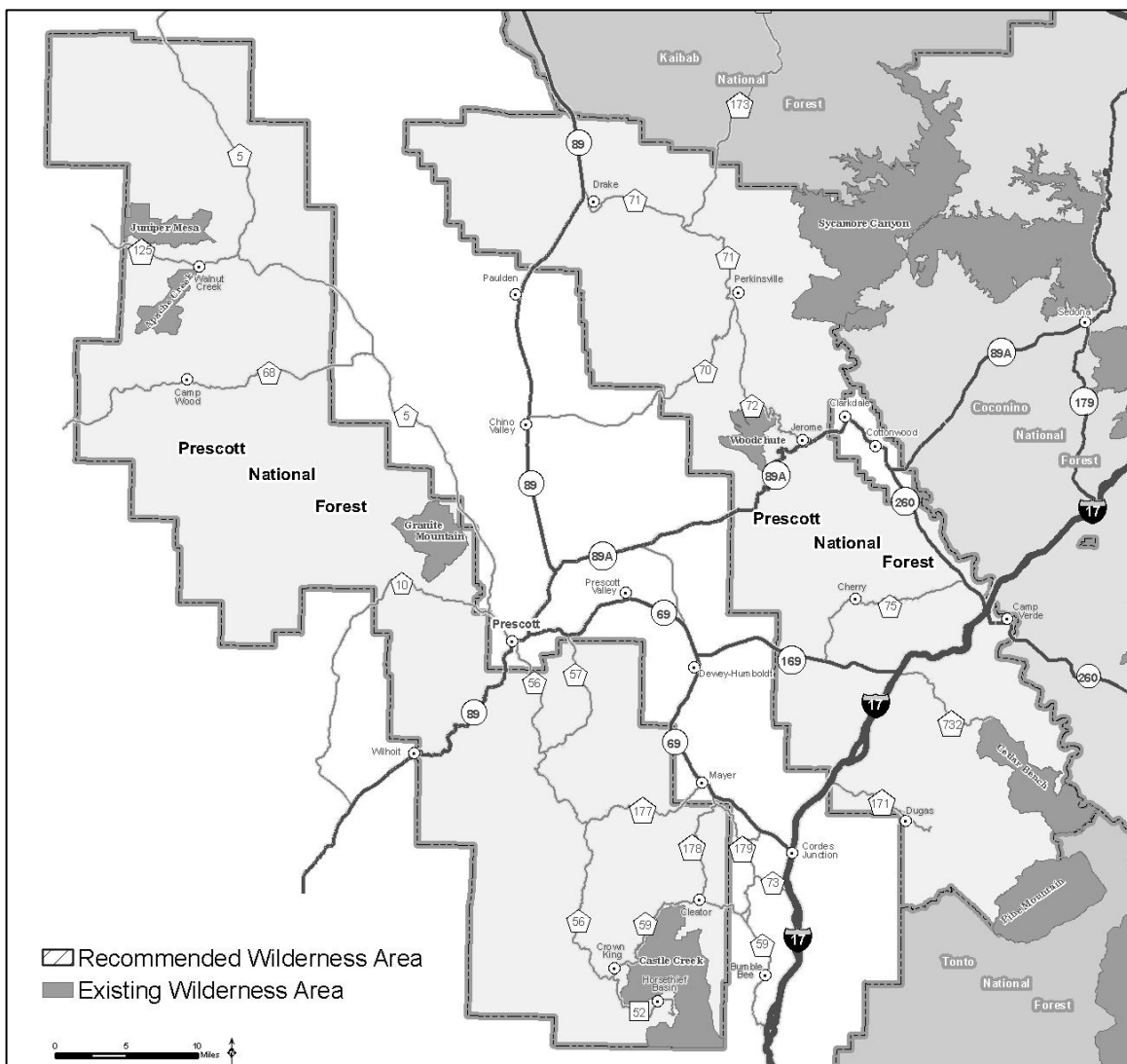


Figure 1. Recommended wilderness for alternatives A and C

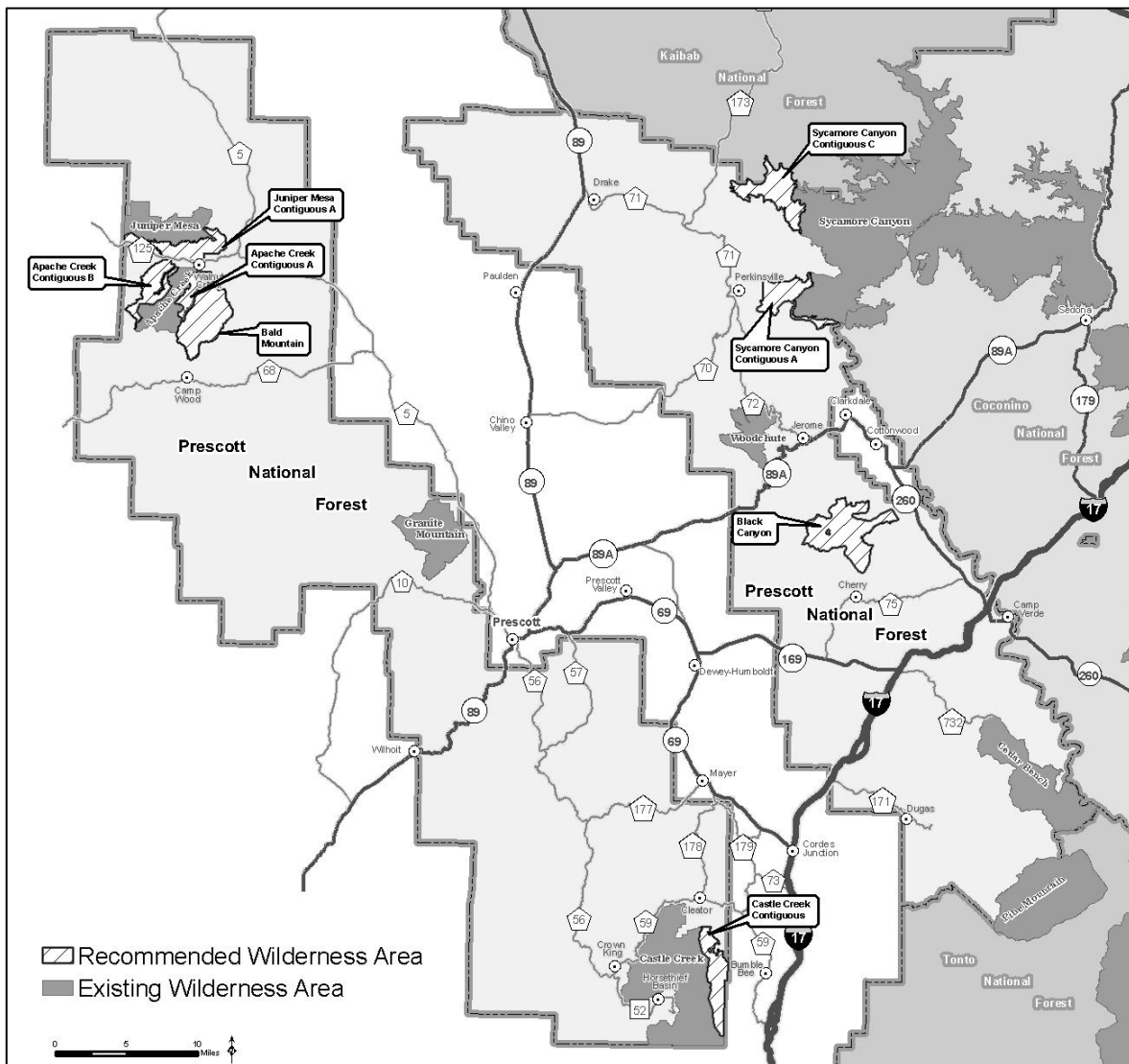


Figure 2. Recommended wilderness for alternative B

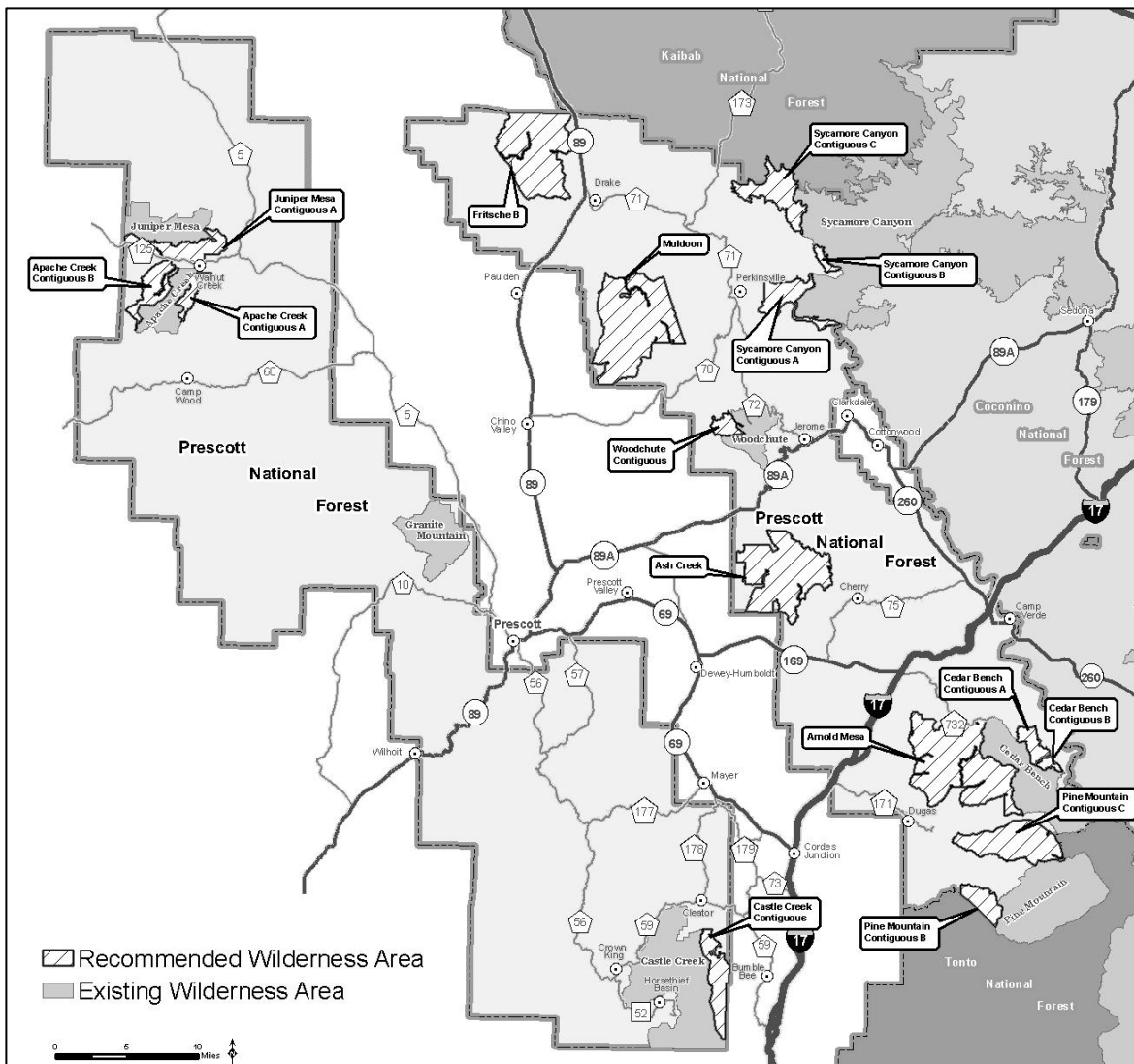


Figure 3. Recommended wilderness for alternative D

Evaluation of Potential Research Natural Areas

Research natural areas (RNAs) are areas that are set aside to create a spectrum of high quality natural communities that are part of a national network for research, education, and maintenance of biological diversity. The process to establish RNAs is documented in the Forest Service Manual 4063. During plan revision, national forests are to consider the need for, and identification of, RNAs. The potential research natural areas on the Prescott NF were evaluated in a 3-step process: (1) review existing information, (2) determine the quality of ecologically underrepresented areas, and (3) recommend areas as potential RNAs. These steps are discussed in further detail below.

Review existing information – Vegetative information specific to the Prescott NF was compared to a list of relatively rare potential natural vegetation types (PNVTs) and aquatic habitats in the Southwestern Region. This comparison was used to determine whether any areas on the Prescott NF were the same as those areas identified as underrepresented RNAs within the Southwestern Region. Six PNVTs and two aquatic habitats met the criteria.

Determine the quality of ecologically underrepresented areas – Each PNVT or aquatic habitat was analyzed to determine whether they met the eight conditions to qualify as a potential RNA. Examples of conditions included: the area represents a specific vegetation type or ecosystem, the area contributes to the preservation and maintenance of genetic diversity, and the area serves as a control for comparing results of manipulative research. One area, the Grapevine Botanical Area, met the conditions as a potential RNA.

Recommend areas as potential RNAs – After review and consideration of the material facts and relevant issues, the forest supervisor elected not to recommend the Grapevine Botanical Area for establishment as an RNA; however, the plan components for managing the Grapevine Botanical Area contained in 1987 plan amendment 10 (1997) were retained for all action alternatives.

Documents that provide additional details on evaluation of RNAs:

- Research Natural Area Process for Forest Plan Revision under the 1982 Planning Rule Provisions (Forest Service, 2009a)
- Environmental Assessment for Grapevine Springs Botanical Area Designation (Forest Service, 1997)
- Prescott National Forest Research Natural Area Evaluation Process Summary Report (Forest Service, 2010a)

Evaluation of Eligible Rivers for Wild and Scenic River Designation

The Wild and Scenic Rivers Act of 1968 sought to preserve the outstandingly remarkable values of selected rivers by retaining their free-flowing condition for the benefit of future generations. Forest Service Handbook 1909.12 section 81.2 states that the list of rivers eligible for wild, scenic, or recreation classification status should be reviewed during plan revision if changes in circumstances have occurred. A 3-step process is described in the Forest Service Handbook: (1)

determine eligibility, (2) classify segments, and (3) determine suitability to pursue congressional designation. Only the first two steps were completed for plan revision on the Prescott NF.

The upper Verde River was determined eligible for addition to the Wild and Scenic Rivers System in 1982 as review showed that changes, such as reduction of amount of private land along the shorelines, road decommissioning, and declines in threatened and endangered fish populations had occurred (Forest Service, 1981).

A recent review (2010) conducted by an interdisciplinary team of specialists determined that eligibility of the upper Verde River for wild and scenic river designation was appropriate; however, the classification of segments needed to be revised. The interdisciplinary team divided the river into four segments using landmarks easily seen in the field.

Using field visits and available information, team members analyzed the following attributes: water resource development, shoreline development, accessibility, and water quality. They compared present circumstances on the river to the classification requirements from the Forest Service Handbook.

Previously, the full extent of the upper Verde River was classified as recreational; however, the updated classifications identified the following segments: 5.6 miles classified as wild, 25.4 miles classified as scenic, and 6.7 miles classified as recreational (table 2).

Table 2. Upper Verde River Wild and Scenic River eligibility

| 1982 Eligibility Classification | |
|---------------------------------|------------|
| Recreational | 37.7 miles |
| 2010 Eligibility Classification | |
| Wild | 5.6 miles |
| Scenic | 25.4 miles |
| Recreational | 6.7 miles |

Documents that provide additional details on eligible wild and scenic rivers:

- Verde River Wild and Scenic River Study Report and Environmental Impact Statement (Forest Service, 1981)
- Upper Verde River Eligibility Report Update for the National Wild and Scenic River System (Forest Service, 2010b)
- Forest Service Handbook 1909.12 Chapter 80

Determination of Suitability for Recreation Opportunities

The National Forest Management Act of 1976 (NFMA) states that national forest plans shall provide for multiple use and sustained yield of products and services through management of renewable surface resources to best meet the needs of the American people. Further, Section 6 of NFMA calls for identification of the suitability of lands for resource management.

The 1982 Planning Rule Provisions require the identification of lands suitable for various recreation opportunities (Sec. 219.21). Forest recreation specialists identified and listed the recreation opportunities (e.g., dispersed camping, motorized recreation) on the Prescott NF, and then identified the settings or areas (e.g., developed recreation facilities, wilderness) where these opportunities may or may not take place.

An area or setting is deemed suitable if it is appropriate for the activity, regardless of whether the opportunity exists. This does not mean that the activity will occur over the entire area. National Forest System lands are generally suitable for a variety of uses, including recreation, unless restricted by Presidential, congressional, or administrative constraints.

A setting is not suitable if it is not appropriate for the activity or the activity is not allowed by law, regulation, or policy within the area. Areas that are permitted for other resource use, such as communication sites, electric substations, mining operations, or energy development, are not suitable for recreation; these settings are also not listed in the suitability matrix.

The results of the suitability analysis are displayed in the recreation suitability matrix (table 3).

Documents that provide additional details on recreation suitability:

- PNF Recreation Suitability Matrix (Forest Service, 2011c)

Table 3. Recreation Suitability Matrix

| | | Activities | | | | | |
|-----------------|-----------------------------------|--|---|---|---|---|---|
| | | Developed Recreation | Dispersed Camping | Nonmotorized Dispersed Recreation | Motorized Recreation | Water Based Recreation | Education/ Interpretation |
| | | – activities that are dependent upon facilities provided by the Forest Service. Examples include developed camping, picnicking, or group gatherings. | – camping outside of a developed campground, including designated dispersed camping, dispersed car camping, and back-country camping. | – activities which are not dependent upon developed facilities or motorized equipment, including hiking, backpacking, hunting, wildlife viewing, rock climbing, or mountain biking. | – the operation of motorized vehicles such as all-terrain vehicles, off-highway vehicles, or motorcycles for recreation as opposed to transportation. | – on water and water adjacent activities such as rafting, tubing, kayaking, boating, swimming, wading, and fishing. Includes both motorized and nonmotorized use. | – recreation based on the pursuit of knowledge and understanding. Ranges from formal displays and programs to outdoor classrooms, interpretive field trips, and citizen-scientist projects. |
| Settings | Developed Recreation Facilities | Suitable | Not Suitable | Not Suitable | Not Suitable | Suitable | Suitable |
| | Heritage Interpretive Area | Suitable | Not Suitable | Suitable | Not Suitable | Not Suitable | Suitable |
| | Wilderness ¹ | Not Suitable | Suitable | Suitable for nonmechanized only | Not Suitable | Suitable | Suitable |
| | Wild and Scenic River | Suitable ² | Suitable | Suitable | Not Suitable | Suitable | Suitable |
| | Grapevine Botanical Area | Not Suitable | Not Suitable | Suitable | Not Suitable | Suitable | Suitable |
| | Nonmotorized Forest System Trails | Not Suitable | Suitable | Suitable | Not Suitable | Not Suitable | Suitable |
| | Motorized Forest System Trails | Not Suitable | Suitable | Suitable where allowed | Suitable | Not Suitable | Suitable |
| | Designated OHV Area | Suitable | Not Suitable | Not Suitable | Suitable | Not Suitable | Suitable |
| | Administrative Facilities | Not Suitable | Not Suitable | Not Suitable | Not Suitable | Not Suitable | Suitable |

¹ Recreation suitability in recommended wilderness is at the discretion of the forest supervisor.

² Developed recreation activities are suitable in river segment corridors classified as “recreational.”

Determination of Suitability for Livestock Grazing

Procedures in the 1982 Planning Rule (Section 219.20) require that the capability and suitability for producing forage for grazing animals on National Forest System lands be determined during forest planning. Capability depends upon conditions such as climate, slope, landform, soils, and geology. Suitability considers the effects of applying certain resource management practices to a particular area of land including relevant social, economic, and ecological factors.

Capability

Capability is the potential of an area of land to produce resources, supply goods and services, or allow resource uses under an assumed set of management practices at a given level of management intensity.

Capable grazing lands refer to the sum of all lands classified as having full or potential grazing capability for domestic livestock. A large portion of the capability determination is based upon factors such as landform, geology, slope, and climate. These have not changed significantly since the previous evaluation undertaken for the 1987 plan. Current drought conditions and trends have not been shown to be outside of historical norms for the Southwest.

Terrestrial ecosystem survey (TES) information, circa 2000, is now used during grazing allotment analysis. For this analysis, three measures are used to determine capability: (1) forage productivity, (2) inherently unstable soils, and (3) slopes steeper than 60 percent.

Forage productivity is taken from TES map unit classifications across the Prescott NF using corporate geographic information system (GIS) data. Inherently unstable soils are described for appropriate map units in TES documentation. The inherently unstable classification is displayed under landscape features and is an interpretation based on climate, soils, rock features, and terrain form. It indicates conditions where annual soil renewability is less than soil loss under natural conditions described in “Potential Plant Community” in the TES document. Therefore, retention of vegetative cover may not slow erosion or soil creep processes even with management intervention, such as seeding. The slope values were determined from U.S. Geological Survey information. Due to the different data sources, there is some overlap between the inherently unstable soil acreage and the acreage of slopes greater than 60 percent. This overlap was determined to be within the margin of error for calculating total acreages.

Lands capable of producing forage for grazing animals totaled 1,009,821 acres (table 4).

Table 4. Grazing capability

| | |
|--|-----------------|
| Prescott NF lands | 1,267,515 acres |
| Forage productivity less than 100 pounds per acre-year | -127,508 acres |
| Soils that are Inherently unstable | -114,786 acres |
| Slopes steeper than 60 percent | -15,400 acres |
| Generally Capable Lands | 1,009,821 acres |

Suitability

Suitability is the appropriateness of applying certain resource management practices to a particular area of land as determined by an analysis of the economic and environmental consequences and the alternative uses foregone. A unit of land may be suitable for a variety of individual or combined management practices. Land suitable for grazing is that which is accessible to livestock or wildlife, can be grazed on a sustained yield basis without damage to long-term productivity, and is compatible with desired conditions.

The 1987 plan identified Management Area 7 as unsuitable for livestock grazing; it consisted of three recreation areas. In addition, the Prescott Municipal watershed (Goldwater Lake) was excluded from grazing based on a 1924 agreement. Lane Mountain watershed was also excluded, beginning in 1975. Desired conditions for these areas include management for their original purpose; thus, they will continue to be unsuitable for livestock grazing.

The area suitable for grazing determined in the 1987 plan was the starting point for determining current range suitability. This area was 977,834 acres.

The planning team identified additional areas which were excluded from livestock grazing, including those excluded by NEPA (National Environmental Policy Act) decisions and portions of allotments that were excluded from grazing activity after 1987. Since inception of the 1987 plan, 50 allotments on the Prescott NF have received site-specific environmental review and several areas were excluded from grazing in project-level decisions. Large, contiguous areas (at least 1,000 acres) that were excluded in site-specific decisions were deemed to be not suitable for livestock grazing for this suitability analysis. These areas totaled 57,055 acres.

Suitable grazing lands were determined to be 920,779 acres (table 5). This figure was calculated by taking the suitable acres (977,834) and subtracting the sum acres of the recent grazing exclusions (57,055); it was applied to all alternatives (A, B, C, and D).

Table 5. Grazing suitability

| | |
|---|----------------|
| Lands suitable for grazing from the 1987 forest plan | 977, 834 acres |
| Allotments where a portion of acreage have been excluded since the 1987 forest plan was approved | -57,055 acres |
| Lands suitable for producing forage for grazing animals, used in forest plan revision alternatives A, B, C, and D | 920,779 acres |

Documents that provide additional details on determining the capability and suitability of livestock grazing:

- Prescott National Forest Determination of Livestock Grazing Capability and Suitability Report (Forest Service, 2011d)
- Terrestrial Ecosystem Survey of the Prescott National Forest (Robertson et al., 2000)

Determination of Suitability for Timber Production

The timber production objective is defined as growing, tending, harvesting, and regenerating crops of trees on a regulated basis to produce logs or other products for industrial or consumer

use (1982 Planning Rule Provisions Section 219.16). For the purposes of forest planning, timber production does not include firewood or harvests from unsuitable lands. NFMA requires the agency to determine the suitability of National Forest System lands for timber production and has specific requirements for timber suitability analysis in land management plans. The Agency makes a distinction between timber harvest as a resource use (i.e., timber production) and timber harvest as a management tool to achieve desired conditions.

These assumptions were used for the timber suitability analysis:

- A minimum 10 percent canopy cover requirement was used to identify areas as being forested for the GIS midscale mapping dataset.
- Piñon-juniper vegetation types were not considered to be forested, regardless of canopy cover, per direction from the Southwestern Region Regional Office.
- Timber production is contrary to desired conditions within areas recommended for wilderness designation. Areas recommended for wilderness designation for each alternative were excluded from the suitable timber base.
- Mexican spotted owl protected activity centers (PACs) and Mexican spotted owl protected areas outside of PACs were removed from the suitable timber base. Trees above 9" d.b.h. (diameter at breast height) are not permitted to be cut within these areas; therefore, commercial timber production is not feasible.
- Different economic thresholds were used for the different alternatives to determine where it was economically efficient to carry out timber production; alternatives A and C had lower economic thresholds than alternatives B and D. Therefore, some tentatively suitable areas were removed from the suitable timber base in alternatives B and D, but there were no areas removed from the suitable base in alternatives A and C.

Tentatively Suitable Timber Lands

The general analysis process first identified lands tentatively suitable for timber production. The first set of criteria for unsuitable lands included:

- Lands that cannot grow trees.
- Lands where current timber harvest technology would cause permanent damage to the natural environment.
- Lands where there is uncertainty that the area can be successfully reforested after harvest.
- Lands that are excluded from harvest by law, by the Secretary of Agriculture, or the Chief of the Forest Service.
- Lands where trees are present, but commercial timber harvest is not economically possible (e.g., lands with volume growth less than 20 cubic feet per acre, lands with no commercial tree species present).

Forest lands that remain after this screening are termed "Lands tentatively suitable for timber production," and this classification does not vary by forest plan alternative. Based on this suitability analysis, 60,839 acres were identified as tentatively suitable for timber production (table 6). This figure serves as the basis for the final timber suitability calculations.

Table 6. Acres tentatively suitable for timber production

| | |
|---|------------------------|
| Total NFS Lands (Prescott National Forest) | 1,255,804 acres |
| Non-forest land | 1,182,829 acres |
| Lands withdrawn from timber production | 12,136 acres |
| Lands where irreversible resource damage likely | 0 acres |
| Lands where adequate restocking not assured | 0 acres |
| Lands Tentatively Suitable for Timber Production | 60,839 acres |

Lands Suitable for Timber Production

The final calculation of lands suitable for timber production involves subtracting the acreage not appropriate for timber production from the tentatively suitable acreage. The categories of lands not appropriate for timber production include:

- Recommended wilderness areas included in each alternative
- Areas where plan components limit timber harvest (acreages were identified by alternative and reflected lands identified as critical to Mexican spotted owls)
- Lands that were not considered economically efficient to carry out timber production (e.g., areas on steep slopes or with blocked access due to recommended wilderness areas).

Table 7. Acres not appropriate for timber production by alternative

| | Alt. A | Alt. B | Alt. C | Alt. D |
|--|---------------|---------------|---------------|---------------|
| Lands where management area prescriptions preclude timber production | 0 | 438 | 0 | 1,124 |
| Lands where management objectives limit timber harvest | 16,426 | 16,426 | 16,426 | 16,426 |
| Lands that are not economically cost efficient | 0 | 5,513 | 0 | 5,226 |
| Lands not appropriate for timber production | 16,426 | 22,377 | 16,426 | 22,776 |

Lands where management area prescriptions preclude timber production would include tentatively suitable land within any potential wilderness area recommended for designation.

On the Prescott NF, lands where management objectives limit timber harvest include areas that have been designated for protection of the Mexican spotted owl (MSO). These 16,426 protected acres are the same across alternatives.

An economic analysis was completed according to direction from the Southwestern Region Regional Office in which the tentatively suitable lands were divided into three broad categories: (1) roaded tractor operable ground, (2) nonroaded tractor operable ground, and (3) and helicopter/cable ground. The helicopter/cable ground had already been removed from the tentatively suitable base because it is the same ground as MSO protected areas outside of PACs. The remaining acres were evaluated according to the costs and revenues of logging.

Suitable timber lands ranged from 38,063 acres to 44,413 acres across alternatives (table 8).

Table 8. Acres suitable for timber production by alternative

| | Alt. A | Alt. B | Alt. C | Alt. D |
|--|---------------|---------------|---------------|---------------|
| Lands tentatively suitable for timber production | 60,839 | 60,839 | 60,839 | 60,839 |
| Lands not appropriate for timber production | 16,426 | 22,377 | 16,426 | 22,776 |
| Lands suitable for timber production | 44,413 | 38,462 | 44,413 | 38,063 |
| Lands not suitable for timber production | 1,211,391 | 1,217,342 | 1,211,391 | 1,217,741 |

Long-term Sustained Yield Capacity

The long-term sustained yield capacity (LTSYC) is defined as the highest uniform yield of wood that lands being managed for timber production may sustain under specified management intensity and consistent with multiple use objectives. Most forest lands are not in a desired condition, so planners use mathematical models to estimate sustainable harvest levels. Short-term harvest levels on lands where timber production is a regular, predictable activity would tend to steadily increase or decrease until those lands are at a desired condition and then remain steady around that level.

The LTSYC for the Prescott NF was calculated using modeling and methodology developed by the Southwestern Region Regional Office. The methodology is discussed further in Youtz and Vandendriesche (2011).

LTSYC calculations for ponderosa pine and its subtypes were based upon uneven-aged forest management systems. The uneven-aged management strategy assumed the following:

- A group selection cutting method.
- A 30-year cutting cycle with six age classes, and where group or patch sizes increase as forested conditions become progressively more mesic (or moist).

The data sources used in calculating LTSYC were Southwestern Region Forest Inventory and Analysis (FIA) plot data (sorted by PNVT and site index) and a regionally calibrated Forest Vegetation Simulator. Based on this data, the annual volumes per acre shown in table 9 would be produced within Ponderosa Pine-Evergreen Oak and Ponderosa Pine-Gambel Oak PNVTs.

Table 9. Annual volume production

| | | |
|------------------------------|-----------------|---------------------------------|
| Ponderosa Pine-Evergreen Oak | High Site Index | 17.8 CCF ¹ acre/year |
| | Low Site Index | 15.8 CCF acre/year |
| Ponderosa Pine-Gambel Oak | High Site Index | 23.7 CCF acre/year |
| | Low Site Index | 15.5 CCF acre/year |

¹ The unit of measure is hundred cubic feet (ccf).

The LTSYC is based on productivity of the land deemed suitable for timber production, and since the suitable acreage varies by alternative, the LTSYC does also. The equation used to calculate

the LTSYC is the timber volume produced per acre per year, multiplied by the suitable timber production acres. For alternatives A and C, LTSYC is 69,680 CCF per decade. For alternative B, LTSYC is 60,343 CCF per decade. For alternative D, LTSYC is 59,706 CCF per decade.

Allowable Sale Quantity

The allowable sale quantity (ASQ) is equal to or less than the amount of timber that could be harvested annually under the LTSYC. For the first decade, it is based on the sale schedule established in the forest plan, and it is projected for future periods. The ASQ should be set high enough to accommodate a base sale schedule (BSS) that reflects a constant or increasing level of planned timber sale offerings to be consistent with the principle of nondeclining flow.

Objective 5 in the proposed revised plan is based on a projected annual average harvest of 800 acres for a 10-year period. This objective did not vary across the action alternatives (B, C, and D); therefore, all the action alternatives share the same ASQ.

Timber volumes that would be produced from activities included in objective 5 were calculated for the 10-year period. The estimate for future volumes was based on past volumes that were produced within ponderosa pine-evergreen oak (PPE) and ponderosa pine-Gambel oak (PPO) since those are the only two vegetation types where there are acres suitable for timber harvest. Although the amount of proposed harvest on suitable lands is the same across the action alternatives, the amount of proposed tree thinning and removal on lands that are not suitable for timber production (e.g., the piñon-juniper PNVTs) varies considerably among alternatives.

The estimate for ASQ under alternative A is 23,385 CCF, and the estimate for ASQ under alternatives B, C, and D is 40,447 CCF. Table 8 below shows the breakdown by PNVT and product type.

Table 10. Allowable sale quantity by alternative

| | Alternative A | | | Alternatives B, C, & D | | |
|-----------------------------------|---------------|---------------|---------------|------------------------|---------------|---------------|
| | Pulp ccf | Saw ccf | Total ccf | Pulp ccf | Saw ccf | Total ccf |
| Ponderosa Pine-Evergreen Oak PNVT | 3,759 | 13,033 | 16,792 | 4,987 | 13,569 | 18,556 |
| Ponderosa Pine-Gambel Oak PNVT | 1,163 | 5,430 | 6,593 | 5,613 | 16,278 | 21,891 |
| Totals | 4,922 | 18,463 | 23,385 | 10,600 | 29,847 | 40,447 |

Documents that provide additional details on timber suitability, LTSYC, and ASQ:

- Prescott National Forest Timber Suitability, Long-term Sustained Yield Capacity, and Allowable Sale Quantity Report (Forest Service, 2011e)
- PNF 2011 Timber Suitability Calculations.xlsx (Spreadsheet)
- National Forest Planning and Sustained Yield of the Timber Resource Long-term Sustained-Yield Calculations for Forest Land and Resource Management Planning (Youtz and Vandendriesche, 2011)

Terrestrial Ecosystem Sustainability Analysis

The first step in evaluating the sustainability of terrestrial ecosystems of the Prescott NF, was to classify the landscape into potential natural vegetation types (PNVTs) as shown in table 11.

PNVTs are coarse-scale groupings of ecosystem types that share similar geography, vegetation, and historic ecosystem disturbances such as fire, drought, and grazing by native species. PNVTs represent the vegetation type and characteristics that would occur when natural disturbance regimes and biological processes prevail on the landscape. It is important not to confuse PNVTs with existing vegetation types.

The PNVT classifications were developed from data available in the “Terrestrial Ecosystem Unit Inventory of the Prescott National Forest” (Robertson et al., 2000) and from information on vegetation dynamics and natural variability compiled by The Nature Conservancy¹ and the Landscape Fire and Resource Management Planning Tools Project² (commonly called LANDFIRE).

Table 11. Potential natural vegetation types (PNVTs) of the Prescott NF

| PNVT Name | Acres | Percent |
|-------------------------------|------------------|----------------|
| Semi-Desert Grassland | 125,712 | 10 |
| Great Basin Grassland | 38,389 | 3 |
| Juniper Grassland | 137,274 | 11 |
| Piñon-Juniper Evergreen Shrub | 463,296 | 37 |
| Interior Chaparral | 315,445 | 25 |
| Ponderosa Pine-Evergreen Oak | 63,539 | 5 |
| Ponderosa Pine-Gambel Oak | 49,052 | 4 |
| Piñon-Juniper Woodland | 36,263 | 3 |
| Desert Communities | 5,919 | < 1 |
| Riparian Gallery Forest | 12,439 | 1 |
| Total | 1,247,328 | 100 |

The status or condition of PNVTs can be evaluated by describing their unique ecosystem characteristics, which consist of a series of “states” and “transitions.” States describe the life forms, composition, age or size, and relative density of the vegetation at different life stages. Transitions are disturbance events that modify the existing vegetation in various ways based on their magnitude, frequency, and extent. Transitions also include biological processes such as growth, development, and death. A “states and transitions” framework allows for simulating and testing vegetation dynamics using computerized models.

¹ http://azconservation.org/downloads/category/southwest_regional/

² www.landfire.gov

The individual vegetation characteristics that were evaluated included species composition, structure (vegetation states) of the dominant life forms (grass, shrub, and tree), and the disturbance regimes that define each PNVT.

This information was used to compare current conditions to descriptions of the historical range of variability (HRV). The HRV characterizes the change in condition, over time and space, of the major vegetation types found in the Southwest. It also describes the ecological processes that shape those types, enabling land managers and the public to understand these drivers of change.

Knowledge of the historical range of variability in these PNVTs allowed us to draw inferences about ecological sustainability and to evaluate the link between current vegetation conditions, past and present management practices, and climatic variability.

For example, the presence of a large number of exotic species in grasslands and riparian communities is a clear indicator that those communities are outside their HRV and, therefore, a potential threat to ecological sustainability of the ecosystem. The encroachment and establishment of woody species into grasslands is another indication that these communities may be outside their HRV. Ecosystem processes were also evaluated within the framework of the HRV, including the disturbance patterns resulting from fire, drought and insects, wind events, and flooding.

PNVT descriptions of the HRV³ were used to represent the reference conditions for analysis, and existing mid-scale vegetation mapping⁴ was used to represent the current conditions.

Desired Conditions Similarity Index Value

A desired conditions similarity index value was calculated for each PNVT representing the relative similarity between the current vegetative conditions and the desired vegetative conditions. Similarity index values are measured on a scale of 1 to 100 with 100 representing maximum similarity. The concept parallels the ecological condition class (ECC) values computed for the “Prescott National Forest Ecological Sustainability Report” (Forest Service, 2009b), where relative departure was also expressed on a scale of 1 to 100. Departure values were based on a comparison of reference conditions to current conditions. The similarity index is based on a comparison of current conditions to desired conditions. Similarity and departure share an inverse relationship. In other words, a PNVT that exhibits a high similarity to desired conditions would inversely exhibit a low departure from reference conditions.

Similarity Index Value Calculation

Table 12 below displays the PNVT states (e.g., A, B, C, D) and class proportions (percentages) for both current and desired conditions for the Ponderosa Pine-Evergreen Oak PNVT, observed on the Prescott NF.

³ PNVT descriptions of characteristic are from two sources: The Nature Conservancy (Schussman and Smith, 2006a and 2006b) and the LANDFIRE Project (LANDFIRE, 2007). A crosswalk was developed to link PNVT descriptions with map units of the “Terrestrial Ecological Unit Inventory of the Prescott National Forest” (Robertson et al., 2000).

⁴ Mid-scale vegetation mapping was conducted in 2005 and 2006 using satellite data and is mapped at the scale of 1:100,000. The map contains geospatial polygons with characteristics of life form (tree, shrub, grass, and forbs), size class (for trees and shrubs), and canopy cover.

To calculate similarity index values: For each vegetation state, the lesser value (current proportion versus desired proportion) is recorded and then summed across vegetation states for a total as shown in underlined text on the right side of the table. Values of 1 to 33 = low similarity; 34 to 66 = moderate similarity; and 67 to 99 = high similarity to desired proportions/conditions. The index value represents the degree of similarity to desired conditions for a given modeled timeframe.

Table 12. PNVT states and class proportions

| VDDT | PNVT State/Class Proportions: | | | | | | Desired Conditions | |
|---------|-------------------------------|----------|----------|-----------|----------|----------|--------------------|---------------------|
| Results | A | B | C | D | E | F | G | Index Value & Label |
| Desired | 4 | 3 | 24 | 60 | 4 | 5 | | |
| Current | 12 | 47 | 1 | 2 | 35 | 3 | | |
| | <u>4</u> | <u>3</u> | <u>1</u> | <u>2</u> | <u>4</u> | <u>3</u> | | <u>17</u> Low |
| Desired | 4 | 3 | 24 | 60 | 4 | 5 | | |
| YR 10 | 6 | 34 | 6 | 18 | 30 | 6 | | |
| | <u>4</u> | <u>3</u> | <u>6</u> | <u>18</u> | <u>4</u> | <u>5</u> | | <u>40</u> Moderate |
| Desired | 4 | 3 | 24 | 60 | 4 | 5 | | |
| YR20 | 4 | 27 | 6 | 24 | 29 | 10 | | |
| | <u>4</u> | <u>3</u> | <u>6</u> | <u>24</u> | <u>4</u> | <u>5</u> | | <u>46</u> Moderate |
| Desired | 4 | 3 | 24 | 60 | 4 | 5 | | |
| YR 40 | 2 | 22 | 6 | 28 | 27 | 15 | | |
| | <u>2</u> | <u>3</u> | <u>6</u> | <u>28</u> | <u>4</u> | <u>5</u> | | <u>50</u> Moderate |
| Desired | 4 | 3 | 24 | 60 | 4 | 5 | | |
| YR 80 | 2 | 21 | 5 | 27 | 28 | 17 | | |
| | <u>2</u> | <u>3</u> | <u>5</u> | <u>27</u> | <u>4</u> | <u>5</u> | | <u>48</u> Moderate |

PNVT States

The figures on the following pages display the current and desired future conditions for each of the 10 PNVTs at the landscape scale. Each PNVT is described by a unique set of states and the proportional difference between current and desired conditions can be discerned. This information provides a set of baseline conditions useful for measuring progress toward desired conditions over time.

Semi-Desert Grassland

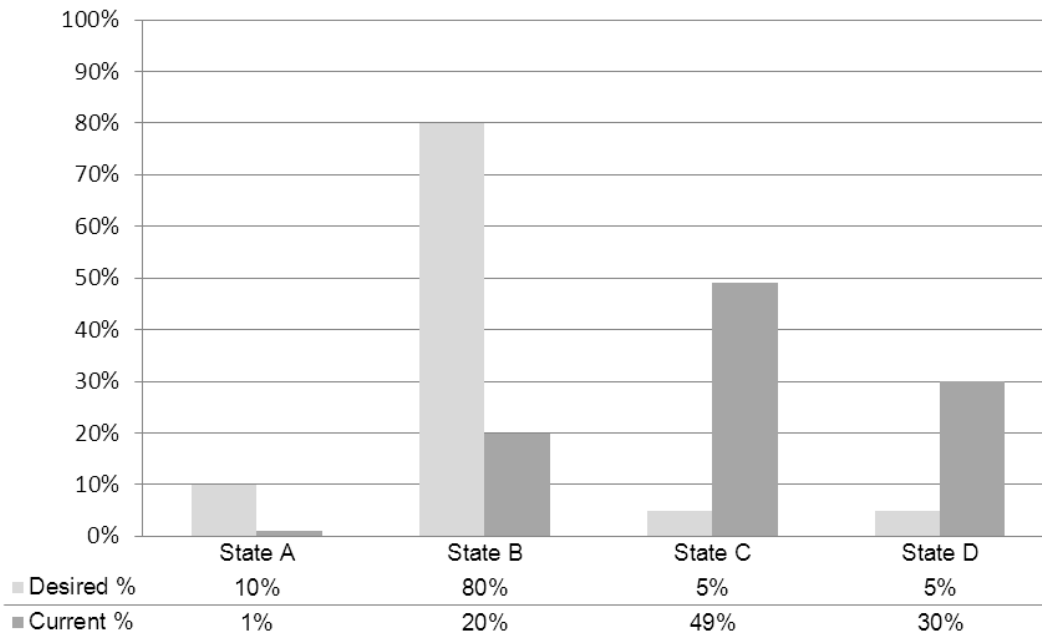


Figure 4. Semi-Desert Grassland

Semi-Desert Grassland PNVV Vegetation Structural States

- State A – Herbaceous vegetation regeneration, recently burned, sparsely vegetated; with < 10 percent tree or shrub canopy cover; early development. Mid-scale vegetation classification codes: RB, SVG.
- State B – Perennial herbaceous vegetation, with < 10 percent tree or shrub canopy cover; mid development. Mid-scale vegetation classification code: GFB.
- State C – Perennial herbaceous vegetation with shrubs, seedling and sapling size (< 5" dia.), small size (5–9.9" dia.) trees with open (< 30 percent) canopy cover; late development; not part of historic conditions, found on contemporary landscapes only. Mid-scale vegetation classification codes: SHO, SSO, SMO.
- State D – Shrubs, seedling and sapling, small, medium size (>20" dia.) trees with closed (≥ 30 percent) canopy cover, and large to very large size trees with open canopy cover with perennial herbaceous vegetation, mid development; not part of historic conditions, found on contemporary landscapes only. Mid-scale vegetation classification codes: SHC, SSC, SMC, VOS.

The Semi-Desert Grassland PNVV exhibits a low similarity (31 percent) to desired conditions. The desired condition descriptions and proportions were developed by the Prescott NF planning team, led by the forest planning ecologist.

Great Basin Grassland

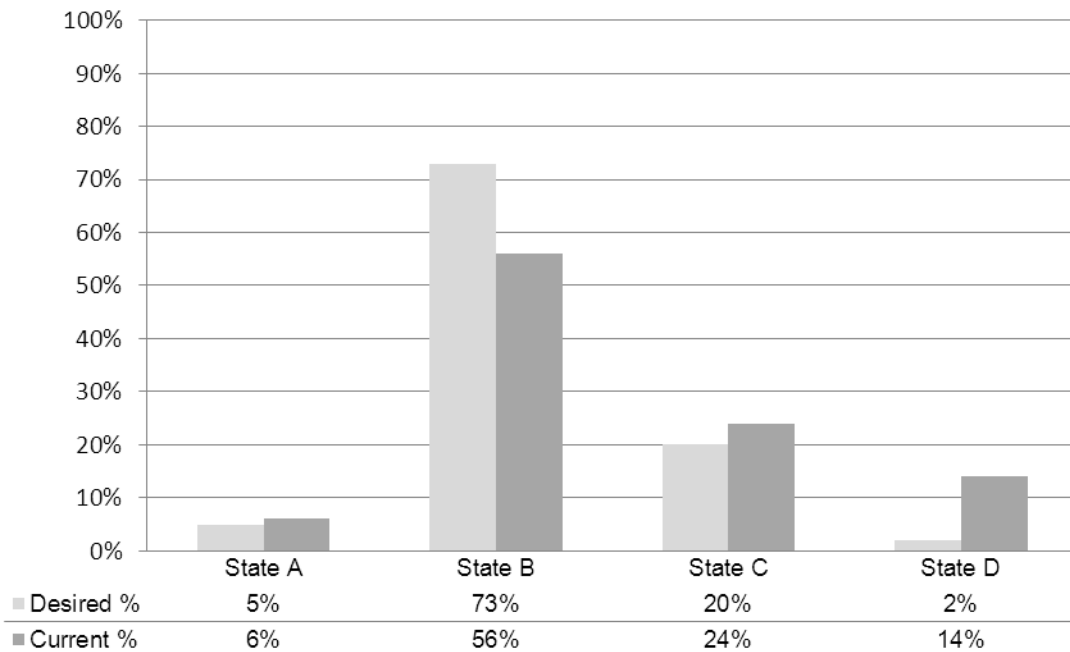


Figure 5. Great Basin Grassland

Great Basin Grassland PNVV Vegetation Structural States

- State A – Herbaceous vegetation regeneration, recently burned, sparsely vegetated; with < 10 percent tree or shrub canopy cover; early development. Mid-scale vegetation classification codes: RB, SVG.
- State B – Open perennial herbaceous vegetation, with < 10 percent tree or shrub canopy cover; mid development. Mid-scale vegetation classification code: GFB.
- State C – Perennial herbaceous vegetation with shrubs, seedling and sapling size (< 5" dia.), small size (5–9.9" dia.), and medium size (10–19.9" dia.) trees with open (< 30 percent) canopy cover; late development. Mid-scale vegetation classification codes: SHO, SSO, SMO, MOS.
- State D – Shrubs, seedling and sapling size (< 5" dia.), small size (5–9.9" dia.), and medium size (10–19.9" dia.) trees with closed (≥ 30 percent) canopy cover: mid development. Mid-scale vegetation classification codes: SHC, SSC, SMC, MCS.

The Great Basin Grassland PNVV exhibits a high similarity (83 percent) to desired conditions. The desired condition descriptions and proportions were developed by the Prescott NF planning team, led by the forest planning ecologist.

Juniper Grassland

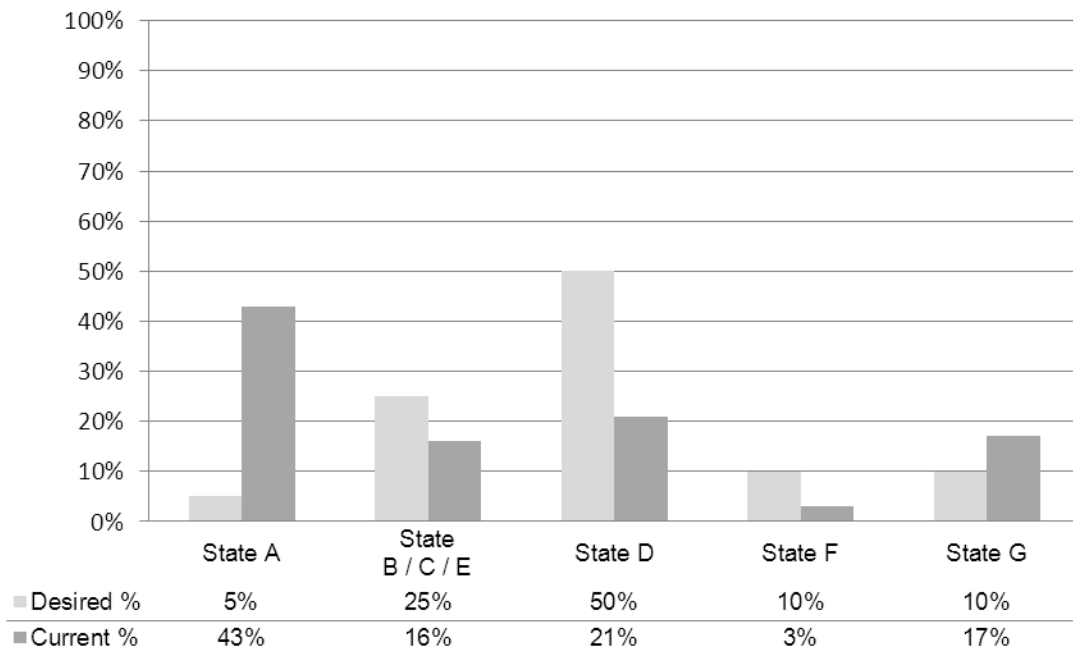


Figure 6. Juniper Grassland

Juniper Grassland PNVV Vegetation Structural States

- State A – Recently burned, grass, forb, and shrub types with < 10 percent tree canopy cover; early development. Mid-scale vegetation classification codes: RB, GFB, SHR.
- State B – Seedling and sapling size (< 5" dia.) trees with open (< 30 percent) canopy cover; all tree types; early development. Mid-scale vegetation classification code: SSO.
- State C – Small size (5–9.9" dia.) trees, with open canopy cover; all tree types; mid development. The current and desired proportion of state C is included in state B. Mid-scale vegetation classification code: SMO.
- State D – Medium and large to very large size (≥ 10" dia.) trees, with open canopy cover; all tree types; late development. Mid-scale vegetation classification code: MVO.
- State E – Seedling and sapling size trees with closed (≥ 30 percent) canopy cover; all tree types; early development. The current and desired proportion of state E is included in state B. Mid-scale vegetation classification code: SSC.
- State F – Small size trees, with closed canopy cover; all tree types; mid development. Mid-scale vegetation classification code: SMC.
- State G – Medium and large to very large size trees, with closed canopy cover; all tree types; late development. Mid-scale vegetation classification code: MVC

The Juniper Grassland PNVV exhibits a moderate similarity (55 percent) to desired conditions. The desired condition descriptions and proportions were provided by the Forest Service Southwestern Region Regional Office.

Piñon-Juniper Evergreen Shrub

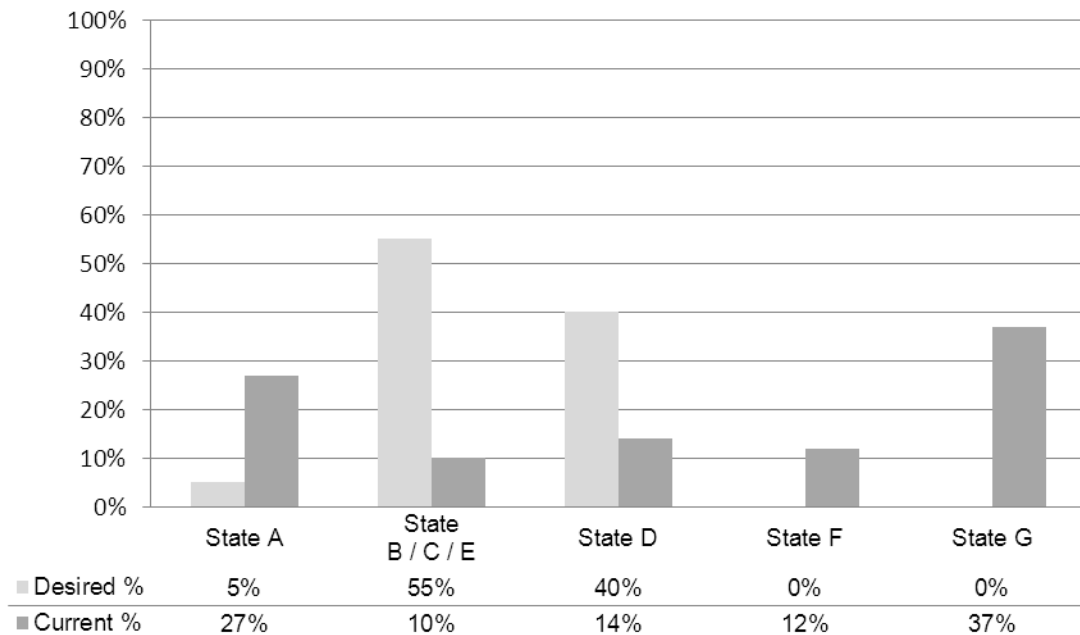


Figure 7. Piñon-Juniper Evergreen Shrub

Piñon-Juniper Evergreen Shrub PNVT Vegetation Structural States

- State A – Recently burned, grass, forb, and shrub types with < 10 percent tree canopy cover; early development. Mid-scale vegetation classification codes: RB, GFB, SHR.
- State B – Seedling and sapling size (< 5" dia.) trees with open (< 30 percent) canopy cover; all tree types; early development. Mid-scale vegetation classification code: SSO.
- State C – Small size (5–9.9" dia.) trees, with open canopy cover; all tree types; mid development. The current and desired proportion of state C is included in state B. Mid-scale vegetation classification code: SMO.
- State D – Medium and large to very large size (≥ 10 " dia.) trees, with open canopy cover; all tree types; late development. Mid-scale vegetation classification code: MVO.
- State E – Seedling and sapling size trees with closed (≥ 30 percent) canopy cover; all tree types; early development. The current and desired proportion of state E is included in state B. Mid-scale vegetation classification code: SSC.
- State F – Small size trees, with closed canopy cover; all tree types; mid development. Mid-scale vegetation classification code: SMC.
- State G – Medium and large to very large size trees, with closed canopy cover; all tree types; late development. Mid-scale vegetation classification code: MVC.

The Piñon-Juniper Evergreen Shrub PNVT exhibits a low similarity (29 percent) to desired conditions. The desired condition descriptions and proportions were provided by the Forest Service Southwestern Region Regional Office.

Piñon-Juniper Woodland

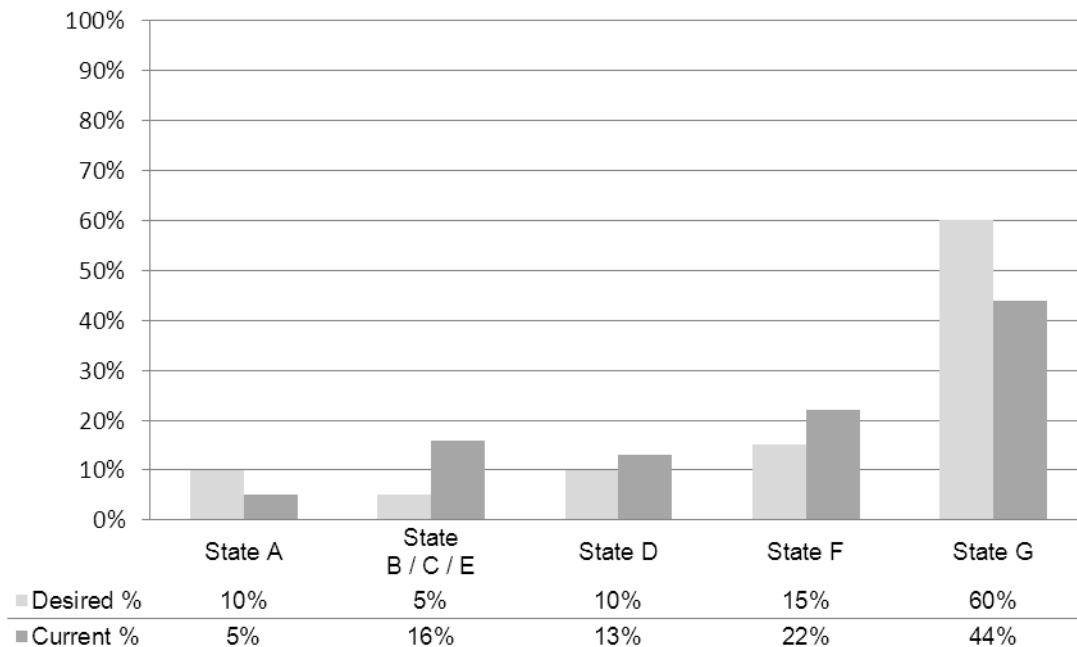


Figure 8. Piñon-Juniper Woodland

Piñon-Juniper Woodland PNVt Vegetation Structural States

- State A – Recently burned, grass, forb, and shrub types with < 10 percent tree canopy cover; early development. Mid-scale vegetation classification codes: RB, GFB, SHR.
- State B – Seedling and sapling size (< 5" dia.) trees with open (< 30 percent) canopy cover; all tree types; early development. Mid-scale vegetation classification code: SSO.
- State C – Small size (5–9.9" dia.) trees, with open canopy cover; all tree types; mid development. The current and desired proportion of state C is included in state B. Mid-scale vegetation classification code: SMO.
- State D – Medium and large to very large size (≥ 10 " dia.) trees, with open canopy cover; all tree types; late development. Mid-scale vegetation classification code: MVO.
- State E – Seedling and sapling size trees with closed (≥ 30 percent) canopy cover; all tree types; early development. The current and desired proportion of state E is included in state B. Mid-scale vegetation classification code: SSC.
- State F – Small size trees, with closed canopy cover; all tree types; mid development. Mid-scale vegetation classification code: SMC.
- State G – Medium and large to very large size trees, with closed canopy cover; all tree types; late development. Mid-scale vegetation classification code: MVC.

The Piñon-Juniper Woodland PNVt exhibits a high similarity (79 percent) to desired conditions. The desired condition descriptions and proportions were provided by the Forest Service Southwestern Region Regional Office.

Interior Chaparral

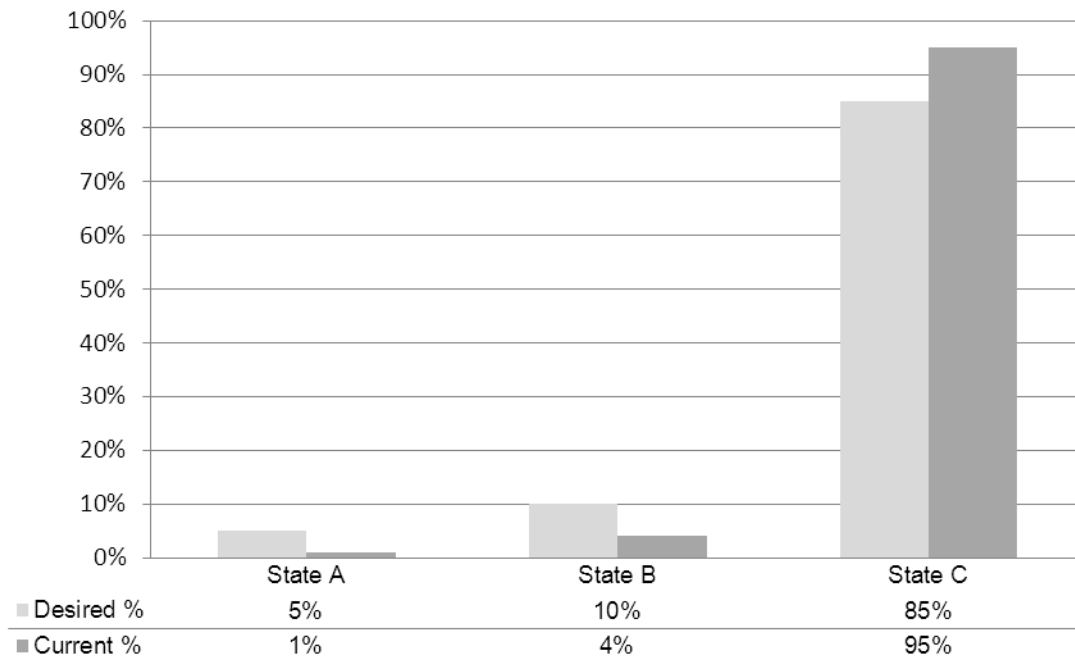


Figure 9. Interior Chaparral

Interior Chaparral PNVV Vegetation Structural States

- State A – Herbaceous vegetation regeneration, recently burned, sparsely vegetated; with < 10 percent shrub or tree canopy cover; early development. Mid-scale vegetation classification codes: RB, SVG, GFB.
- State B – Open perennial herbaceous vegetation, with shrubs, seedling and sapling size (< 5" dia.) and small size (5–9.9" dia.) trees with open (<30 percent) canopy cover; mid development. Mid-scale vegetation classification code: SHO, SSO, SMO.
- State C – Shrubs, seedling and sapling, small, and medium size (10–19.9" dia.) trees with closed (≥ 30 percent) canopy cover with no herbaceous vegetation understory; late development. Mid-scale vegetation classification code: SHC, SSC, SMC, MVC.

The Interior Chaparral PNVV exhibits a high similarity (90 percent) to desired conditions. The desired condition descriptions and proportions were developed by the Prescott NF planning team, led by the forest planning ecologist.

Ponderosa Pine-Evergreen Oak

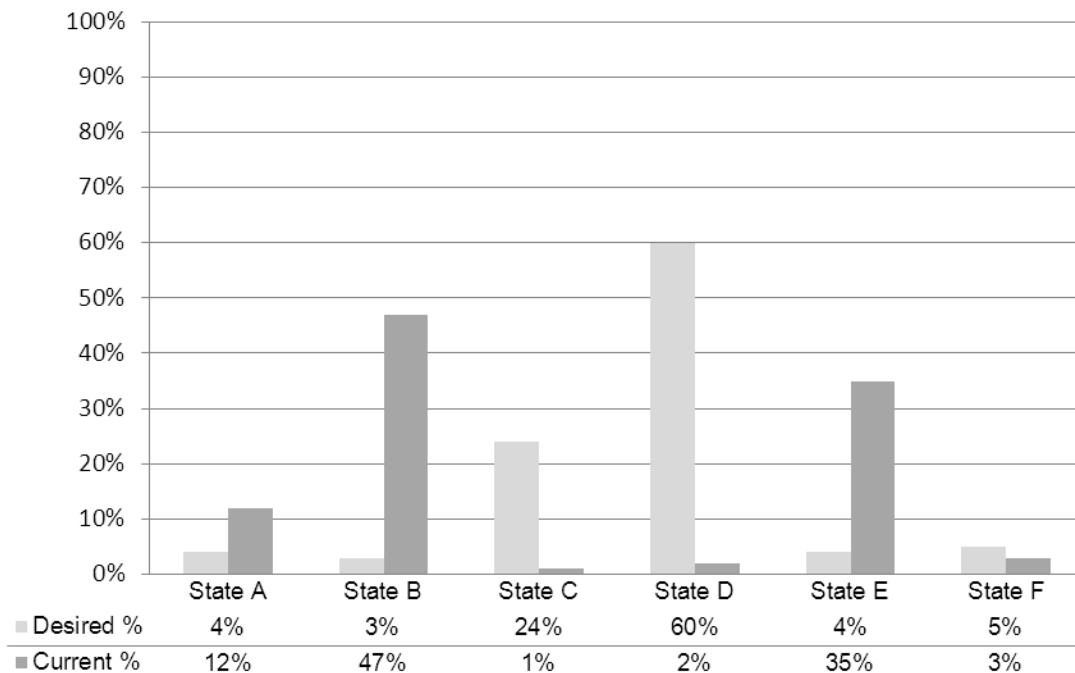


Figure 10. Ponderosa Pine-Evergreen Oak

Ponderosa Pine-Evergreen Oak PNVT Vegetation Structural States

- State A – Recently burned, grass, forb, and shrub types with < 10 percent tree canopy cover; early development. Mid-scale vegetation classification codes: RB, SVG, GFB.
- State B – Small size (5–9.9" dia.) trees, with closed (≥ 30 percent) cover; all tree types; mid development. Mid-scale vegetation classification code: SMC.
- State C – Small size (5–9.9" dia.) trees, with open canopy cover; all tree types; mid development. Mid-scale vegetation classification code: SMO.
- State D – Medium and large to very large size (≥ 10 " dia.) trees, with open canopy cover; all tree types; late development. Mid-scale vegetation classification code: MVO.
- State E – Medium and large to very large size (≥ 10 " dia.) trees, with closed (≥ 30 percent) cover; all tree types; late development. Mid-scale vegetation classification code: MVC.
- State F – Resprouter dominated seedling and sapling size trees with closed (≥ 30 percent) canopy cover; all tree types; early development. Mid-scale vegetation classification code: SSA.

The Ponderosa Pine-Evergreen Oak PNVT exhibits a low similarity (24 percent) to desired conditions. The desired condition descriptions and proportions were provided by the Forest Service Southwestern Region Regional Office.

Ponderosa Pine-Gambel Oak

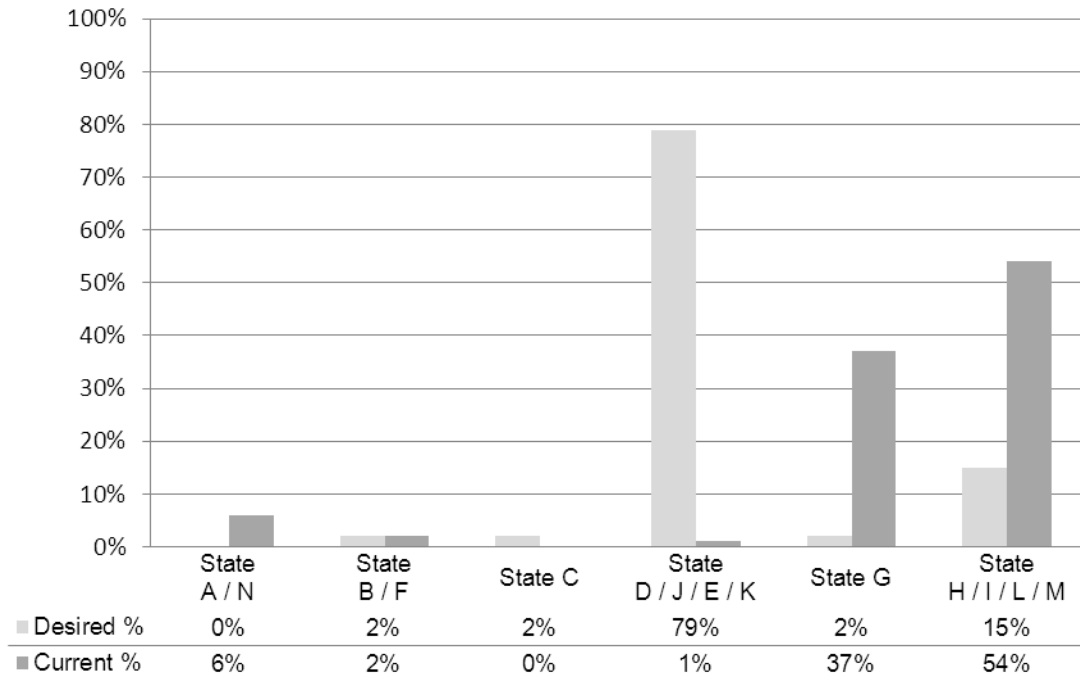


Figure 11. Ponderosa Pine-Gambel Oak

Ponderosa Pine-Gambel Oak PNVT Vegetation Structural States

- State A – Recently burned, grass, forb, and shrub types with < 10 percent tree canopy cover; early development. Mid-scale vegetation classification codes: GFB, SHR.
- State B – Seedling and sapling size (< 5" dia.) trees with open (< 30 percent) canopy cover; all tree types; early development. Mid-scale vegetation classification code: SSO.
- State C – Small size (5–9.9" dia.) trees, with open canopy cover; all tree types; mid development. Mid-scale vegetation classification code: SMO.
- State D – Medium size (10–19.9" dia.) trees, single storied, with open canopy cover; all tree types; late development. Mid-scale vegetation classification code: MOS.
- State E – Large to very large size (≥ 20" dia.) trees, single storied, with open canopy cover; all tree types; late development. Mid-scale vegetation classification code: VOS.
- State F – Seedling and sapling size trees with closed (≥ 30 percent) canopy cover; all tree types; early development. Mid-scale vegetation classification code: SSC.
- State G – Small size trees, with closed canopy cover; all tree types; mid development; not part of the historic conditions, found on contemporary landscapes only. Mid-scale vegetation classification code: SMC.
- State H – Medium size trees, single storied, with closed canopy cover; all shade tree types; late development; not part of historic conditions, found on contemporary landscapes only. Mid-scale vegetation classification codes: MCS.

Appendix B. Description of the Analysis Process

- State I – Large to very large size trees, single storied, with closed canopy cover; all tree types; late development; not part of historic conditions, found on contemporary landscapes only. Mid-scale vegetation classification code: VCS.
- State J – Medium size trees, multistoried, with open canopy cover; all tree types; late development. This state does not currently exist on the Prescott NF. Mid-scale vegetation classification code: MOM.
- State K – Large to very large size trees, multistoried, with open canopy cover; all tree types; late development. This state does not currently exist on the Prescott NF. Mid-scale vegetation classification code: VOM.
- State L – Medium size trees, multistoried, with closed canopy cover; all tree types; late development; not part of historic conditions, found on contemporary landscapes only. This state does not currently exist on the Prescott NF. Mid-scale vegetation classification code: MCM.
- State M – Large to very large size trees, multistoried, with closed canopy cover; tree types; late development; not part of historic conditions, found on contemporary landscapes only. This state does not currently exist on the Prescott NF. Mid-scale vegetation classification code: VCM.
- State N – Recently burned, grass, forb, and shrub types with < 10 percent tree canopy cover; uncharacteristic early development due to fire; not part of historic conditions, found on contemporary landscapes only. Mid-scale vegetation classification code: GFB, SHR.

The Ponderosa Pine-Gambel Oak PNVT exhibits a low similarity (20 percent) to desired conditions. The desired condition descriptions and proportions were provided by the Forest Service Southwestern Region Regional Office.

Desert Communities

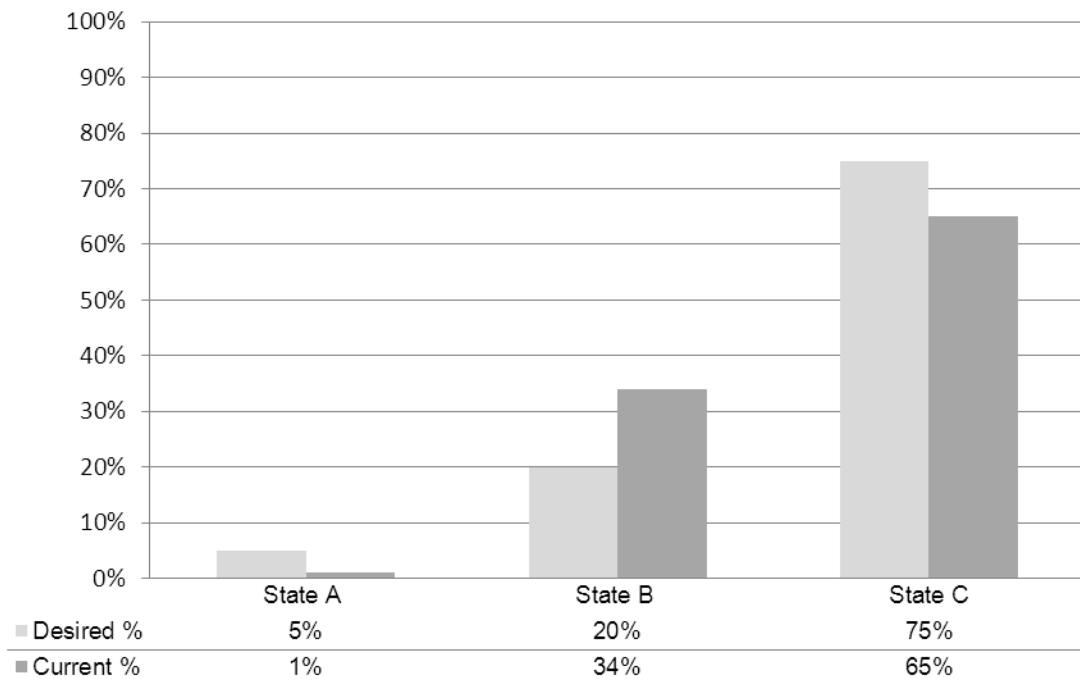


Figure 12. Desert Communities

Desert Communities PNVT Vegetation Structural States

- State A – Herbaceous vegetation, recently burned, sparsely vegetated; with < 10 percent tree or shrub canopy cover; early development. Mid-scale vegetation classification codes: RB, SVG, GFB.
- State B – Shrubs, and small woody plants and trees (1–9.9" dia.), with open (< 30 percent) canopy cover; mid development. Mid-scale vegetation classification code: SHO.
- State C – Shrubs, medium size or larger (>10" dia.) cactus and trees with open (< 30 percent) canopy cover; late development. Mid-scale vegetation classification code: SHC, SSO, SMO, SMC, MVO.

The Desert Communities PNVT exhibits a high similarity (86 percent) to desired conditions. The desired condition descriptions and proportions were provided by the Forest Service Southwestern Region Regional Office.

Riparian Gallery Forest

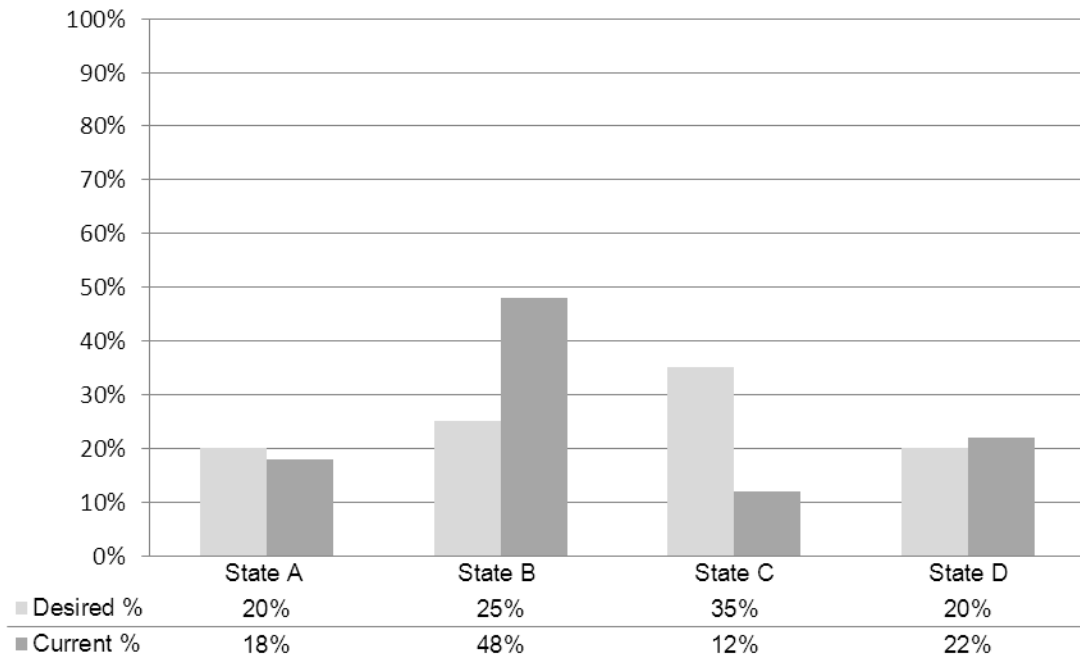


Figure 13. Riparian Gallery Forest

Riparian Gallery Forest PNVT Vegetation Structural States

- State A – Herbaceous vegetation regeneration, recently burned, sparsely vegetated; shrubs, seedling, and sapling size (< 5" dia.) trees; early development. Mid-scale vegetation classification codes: RB, SVG, GFB, SHR, SSA.
- State B – Small size (5–9.9" dia.), and medium size (10–19.9" dia.) trees with generally closed (>30 percent) canopy cover; mid development. Mid-scale vegetation classification code: SMO, SMC, MOS, MCS.
- State C – Large to very large size (>20" dia.) trees with open or closed canopy cover; late development. Mid-scale vegetation classification codes: VCS, VOS.
- State D – Mesquite dominated shrub mixes; late development closed (>30 percent) canopy cover. Mid-scale vegetation classification codes: SHR.

The Riparian Gallery Forest PNVT exhibits a high similarity (75 percent) to desired conditions. The desired condition descriptions and proportions were provided by the Forest Service Southwestern Region Regional Office.

VDDT Modeling

The Vegetation Dynamics Development Tool (VDDT), Version 6.0.25 (ESSA Technologies, 2006), a Windows-based computer application, was used to forecast the response of the potential natural vegetation types to human caused and natural disturbance events and agents proposed or expected under each of the plan alternatives. The software allowed for the nonspatial modeling of a series of vegetation states that differ in structure, composition, and canopy cover and to specify the amount of time it takes to move from one vegetation state to another in the absence of disturbance.

Various disturbance agents affecting the movement of vegetation between states (or transitions) are incorporated (e.g., mechanical vegetation treatments, surface fires, mixed-severity fires, stand-replacing fires, grazing, insect outbreaks, and drought events). By varying the types and rates of disturbance across the landscape, the effects of different disturbance regimes, such as historic and current fire regimes, or different management treatments, such as planned and unplanned fire ignitions, fire suppression, grazing practices, and mechanical fuel treatments, on vegetation can be investigated (Schussman and Smith, 2006a). Input data used in modeling came directly from forest management activities and fire data over the last 25 years.

State destinations and transition probabilities for vegetation treatments were derived from Forest Vegetation Simulator (FVS), modeling, Version 6.31. FVS is a distance independent; individual tree forest growth model widely used in the United States and is used to compare alternatives.

State destinations for natural fires and fire treatments were derived from FVS modeling, Version 2.02 and Fire and Fuel Extension (FFE) (Rebain, 2010). Forest Inventory and Analysis (FIA) plot data were used to calibrate the VDDT model to estimate relative proportions of even- and uneven-aged conditions on the forests (Weisz et al., 2012).

The following PNVTs were modeled using VDDT software: Ponderosa Pine-Gambel Oak, Ponderosa-Pine Evergreen Oak, Piñon-Juniper Evergreen Shrub, and Juniper Grassland. These PNVt models were developed by the Forest Service Southwestern Regional Office. The VDDT models for Interior Chaparral, Semi-Desert Grassland, and Great Basin Grassland PNVTs were developed by the Forest Service at the forest level and reviewed at the regional level prior to analysis.

Some of the drawbacks and limitations of VDDT modeling are:

- VDDT is a nonspatial, long-range strategic model. It does not describe what is happening at a site-specific level of detail and is intended mainly for broad-scale analysis.
- Some of the VDDT inputs used were derived from other modeling outputs, for example FVS timber harvest treatment state transition destinations and the probability of those outcomes.
- The VDDT model divides vegetation conditions within each PNVt into a small number of discrete states, and it is acknowledged that there is more variability within each state than has been modeled.
- VDDT models overstory structure, composition, and cover as defined by mid-scale vegetation mapping in great detail, but does not model the understory vegetation (for example, the species composition of grasses and forbs).

- VDDT modeled the distribution of landscape states over time, and does not model the more detailed physical (e.g. soil temperature, precipitation, aspect, elevation, productivity), chemical, and biological dynamics of what is happening at each scale of spatial resolution.
- VDDT models the probability and timing of events (e.g., fire behavior, management activities, insect and disease occurrences) based on empirical observations, but cannot accurately predict future behavior due to climate change or other phenomena outside of the historic range of variability.

It was assumed that the disturbances (e.g., management activities) selected for the VDDT model represent the majority of disturbances the Prescott NF experiences. There could be many variations to these disturbances; however, these were not modeled in detail for this analysis. According to Lauenroth and Laycock (1989) and others, succession may follow multiple pathways and reach different end points depending on the effects of disturbance on the life history characteristics of the vegetation; causing predictability to be limited by the importance of chance or infrequent events.

The results of each PNVT model run were recorded in electronic spreadsheets, and calculations of differences between alternatives were performed. PNVT end states were compiled for each alternative and comparisons made between alternatives for similarity to desired condition descriptions and proportions of open canopy states; results were then supplemented by other extra model information for disclosure in the environmental effects analysis.

Vegetation Treatments

Management activities including tree thinning, shrub removal, and prescribed fire were input into individual VDDT models to estimate the resulting movement toward or away from desired conditions, the proportions of each vegetation state, and the expected fire frequency.

Alternative A was modeled using the average number of acres treated over a 10-year period (table 13). The action alternatives (B, C, and D) were modeled at both the minimum (tables 14, 16, and 18) and maximum (tables 15, 17, and 19) proposed treatment levels to determine the potential range of outcomes. These outcomes were used to calculate the progress toward desired conditions under a range of treatment levels. This provided the basis for comparison of the trends established by the low and high levels of treatment for each alternative.

The vegetation treatments modeled for each alternative are summarized in the tables below.

The following codes were used to represent the modeled PNVTs:

- SDG Semi-Desert Grassland
- CPGB Great Basin Grassland
- JUG Juniper Grassland
- PJC Piñon-Juniper Evergreen Shrub
- CHAP Interior Chaparral
- PPE Ponderosa Pine-Evergreen Oak
- PPO Ponderosa Pine-Gambel Oak

The Piñon-Juniper Woodland, Desert Communities, and Riparian Gallery Forest PNVTs were not modeled for treatments.

Table 13. Average annual treatment acres for alternative A

| Treatment | SDG | CPGB | JUG | PJC | CHAP | PPE | PPO | Totals |
|------------------|------------|-------------|------------|--------------|--------------|--------------|------------|---------------|
| Rx Thin acres | 0 | 0 | 148 | 166 | 159 | 483 | 71 | 1,027 |
| Rx Fire acres | 914 | 6 | 408 | 1,568 | 3,103 | 1,457 | 379 | 7,835 |
| Totals | 914 | 6 | 556 | 1,734 | 3,262 | 1,940 | 450 | 8,862 |

Table 14. Lower-end average annual treatment acres for alternative B

| Treatment | SDG | CPGB | JUG | PJC | CHAP | PPE | PPO | Totals |
|-------------------|--------------|-------------|------------|--------------|--------------|--------------|------------|---------------|
| Rx Thin Low acres | 0 | 0 | 150 | 150 | 200 | 125 | 125 | 750 |
| Rx Fire Low acres | 2,500 | 100 | 500 | 1,200 | 3,800 | 2,000 | 500 | 10,600 |
| Totals | 2,500 | 100 | 650 | 1,350 | 4,000 | 2,125 | 625 | 11,350 |

Table 15. Higher-end average annual treatment acres for alternative B

| Treatment | SDG | CPGB | JUG | PJC | CHAP | PPE | PPO | Totals |
|--------------------|--------------|-------------|--------------|--------------|---------------|--------------|--------------|---------------|
| Rx Thin High acres | 0 | 0 | 200 | 2,000 | 3,500 | 400 | 400 | 6,500 |
| Rx Fire High acres | 6,500 | 500 | 800 | 6,000 | 6,500 | 4,000 | 1,000 | 25,300 |
| Totals | 6,500 | 500 | 1,000 | 8,000 | 10,000 | 4,400 | 1,400 | 31,800 |

Table 16. Lower-end average annual treatment acres for alternative C

| Treatment | SDG | CPGB | JUG | PJC | CHAP | PPE | PPO | Totals |
|-------------------|--------------|-------------|------------|--------------|--------------|--------------|------------|---------------|
| Rx Thin Low acres | 0 | 0 | 150 | 150 | 200 | 125 | 125 | 750 |
| Rx Fire Low acres | 6,500 | 500 | 500 | 1,200 | 3,800 | 2,200 | 800 | 15,500 |
| Totals | 6,500 | 500 | 650 | 1,350 | 4,000 | 2,325 | 925 | 16,250 |

Table 17. Higher-end average annual treatment acres for alternative C

| | SDG | CPGB | JUG | PJC | CHAP | PPE | PPO | Totals |
|--------------------|------------|-------------|------------|------------|-------------|------------|------------|---------------|
| Rx Thin High acres | 0 | 0 | 200 | 1,000 | 2,000 | 400 | 400 | 4,000 |
| Rx Fire High acres | 8,500 | 1,000 | 800 | 2,000 | 4,000 | 4,500 | 2,000 | 22,800 |
| Totals | 8,500 | 1,000 | 1,000 | 3,000 | 6,000 | 4,900 | 2,400 | 26,800 |

Table 18. Lower-end average annual treatment acres for alternative D

| | SDG | CPGB | JUG | PJC | CHAP | PPE | PPO | Totals |
|-------------------|------------|-------------|------------|------------|-------------|------------|------------|---------------|
| Rx Thin Low acres | 0 | 0 | 150 | 150 | 200 | 125 | 125 | 750 |
| Rx Fire Low acres | 2,500 | 100 | 500 | 1,200 | 3,800 | 2,000 | 500 | 10,600 |
| Totals | 2,500 | 100 | 650 | 1,350 | 4,000 | 2,125 | 625 | 11,350 |

Table 19. Higher-end average annual treatment acres for alternative D

| | SDG | CPGB | JUG | PJC | CHAP | PPE | PPO | Totals |
|--------------------|------------|-------------|------------|------------|-------------|------------|------------|---------------|
| Rx Thin High acres | 0 | 0 | 200 | 1,000 | 2,000 | 400 | 400 | 4,000 |
| Rx Fire High acres | 6,500 | 500 | 800 | 2,000 | 4,000 | 4,000 | 1,000 | 18,800 |
| Totals | 6,500 | 500 | 1,000 | 3,000 | 6,000 | 4,400 | 1,400 | 22,800 |

Other Data Sources and Assumptions

Other data sources used in the vegetation and fire ecology analysis include the summary field information compiled for the “Ecological Classification of the Prescott National Forest” (Girard et. al., 2008) and corporate data on wildland fire occurrence.

Assumptions that were part of the analysis include:

- The population and calibration of VDDT using FIA plots and FVS modeling of growth and disturbances generally represents the response of PNVTs well enough to compare outcomes proposed by the various alternatives in terms of desired conditions and treatment objectives.
- A range of treatment activities is proposed for each alternative. The VDDT model was used to estimate outcomes at the minimum and maximum levels of treatment for each vegetation and fire management objective.

- Because some of the treatment objectives target a combination of PNVTs, it was necessary to assign treatment levels to individual PNVTs based on testing of VDDT model sensitivity, existing and desired conditions, and professional judgment. As an example, objective-3 under alternative B states, “Treat 20,000 to 90,000 acres in juniper grasslands, piñon-juniper shrublands, or piñon-juniper woodlands PNVTs using mechanical treatments, fire, or domestic livestock ...” The objective does not specifically define how much of each activity is to occur for each PNV. The specific model inputs used for each alternative are displayed above.

Documents that provide additional details on the vegetation and fire ecology analysis:

- Mapping existing vegetation at the mid-scale level in the Forest Service Southwestern Region. (Mellin et. al., 2008)
- Evaluating the ecological sustainability of a piñon-juniper grassland ecosystem in Northern Arizona. (Weisz et. al., 2010)
- Ecological Classification of the Prescott National Forest (Girard et. al., 2008)
- Prescott National Forest Vegetation and Fire Ecology Specialist Report. (Forest Service, 2011j)

Watershed Analysis

An initial watershed condition assessment for the planning area was performed at the subbasin and watershed levels as reported in the “Ecological Sustainability Report” (Forest Service, 2009b). The effects analysis for the proposed revised plan and alternatives used the findings from the “Ecological Sustainability Report” as well as additional information at the subwatershed level that became available in 2011 from development of the Watershed Condition Classification (WCC) system.

The WCC system uses 12 watershed condition indicators to assess and classify the overall state of each subwatershed. These indicators and their attributes represent the underlying factors that affect soil and hydrologic function. Most of the indicators can be affected through management actions to maintain or improve watershed condition. This structure provides for a direct linkage between the classification system and management or improvement activities the Forest Service conducts on the ground.

Each of the individual indicators were assessed on their attributes and assigned a rating which falls into one of three classes (table 20):

- **Class 1** - Functioning watersheds exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition and are functioning properly.
- **Class 2** – At risk watersheds exhibit moderate geomorphic, hydrologic, and biotic integrity relative to their natural potential condition and are functioning at risk of impairment.
- **Class 3** - Impaired watersheds exhibit low geomorphic, hydrologic, and biotic integrity relative to their natural potential condition and are functioning in an impaired condition.

Table 20. Number of Prescott NF watersheds by condition class indicator

| Condition Class | Aquatic Physical | | | Aquatic Biological | | Terrestrial Physical | | Terrestrial Biological | | | | |
|-----------------|------------------|-------------------|--------------------|--------------------|------------------------|----------------------|----------|------------------------|-----------------|--------------------------|----------------------|-------------------|
| | 1. Water Quality | 2. Water Quantity | 3. Aquatic Habitat | 4. Aquatic Biota | 5. Riparian Vegetation | 6. Roads and Trails | 7. Soils | 8. Fire Regime | 9. Forest Cover | 10. Rangeland Vegetation | 11. Invasive Species | 12. Forest Health |
| Functioning | 68 | 61 | 29 | 33 | 28 | 0 | 6 | 3 | 39 | 2 | 97 | 97 |
| At Risk | 23 | 23 | 44 | 52 | 52 | 12 | 46 | 91 | 4 | 34 | 0 | 0 |
| Impaired | 6 | 13 | 24 | 12 | 17 | 85 | 45 | 3 | 54 | 61 | 0 | 0 |

The individual indicator scores were grouped into four categories which were then weighted and summed to produce an overall condition rating for each subwatershed. The aquatic physical (table 20, indicators 1 to 3) and aquatic biological (table 20, indicators 4 and 5) categories are weighted at 30 percent each because of their direct impact to aquatic systems. The terrestrial physical category (table 20, indicators 6 and 7) is weighted at 30 percent because roads are typically one of the highest sources of impact to watershed condition. The terrestrial biological category (table 20, indicators 8 to 12) is weighted at 10 percent because these indicators have indirect impact to watershed condition. The overall watershed condition scores were tracked to one decimal point, with Class 1 = scores of 1.0 to 1.6, Class 2 = scores from 1.7 to 2.2, and Class 3 = scores from 2.3 to 3.0.

Eighty-three of the subwatersheds administered at least in part by the Prescott NF were rated as “at risk” condition. At the watershed scale, 21 of the 22 watersheds also received an overall “at risk” rating (table 21).

Table 21. Overall watershed and subwatershed conditions

| Condition Class | Number of Watersheds | Number of Subwatersheds |
|-----------------|----------------------|-------------------------|
| 1 – Functioning | 1 | 12 |
| 2 – At Risk | 21 | 83 |
| 3 – Impaired | 0 | 2 |

The individual and overall watershed condition indicator ratings were developed for the WCC system at the subwatershed level; however, for plan revision analysis, they were also aggregated up to the watershed level to facilitate comparison with the prior analysis compiled for the “Ecological Sustainability Report” (Forest Service, 2009b).

The ratings for individual condition indicators were used in analyzing the potential effects of the proposed revised plan and its alternatives. Seven of the watershed condition indicators were chosen that best reflect the consequences of recreation use and management in the watersheds and subwatersheds. They include:

- Riparian/Wetland Vegetation
- Roads and Trails
- Soils
- Fire Regime or Wildfire
- Forest Cover
- Rangeland Vegetation
- Water Quality

Documents that provide additional details on the hydrology and soils analysis:

- Prescott National Forest Plan Revision EIS Hydrology and Soils Specialist Report (Forest Service, 2011k)
- Watershed Condition Classification Technical Guide. FS-978 (Forest Service, 2011m)
- USDA Forest Service Watershed Condition Classification Dataset (Forest Service, 2011n)
- Ecological Sustainability Analysis of the Prescott National Forest: An Evaluation of Water Resource Characteristics, and their Contribution in Ecological Diversity and Ecological Sustainability (Forest Service, 2008a)
- Ecological Sustainability Report (Forest Service, 2009b)

Species Viability Analysis

In the 1982 Planning Rule Provisions, national forests are required to manage for viable populations of native and desired nonnative vertebrate species in the planning area (Sec. 219.19). Direction in the Forest Service Manual adds plants and invertebrates to the species to be analyzed in the viability process.

Viable populations are considered those that have: (1) at least a minimum number of reproductive individuals and (2) habitat that is well distributed so individuals or populations can interact with others in the planning area.

The evaluation of effects on species viability of the proposed revised plan and its alternatives is based on the effects to the ecological conditions that provide for ecosystem diversity (FSH 1909.12, Chap. 40, and Sec. 43.21). The overall assumption of ecosystem management is that managing systems within the range of conditions that native species have experienced over evolutionary time is likely to maintain populations of those species. The evaluation of effects will be assessed as a risk to species viability from the proposed revised plan and its alternatives.

Risk is comprised of two components: the likelihood of a negative outcome and the severity of a negative outcome. From an ecological standpoint, a negative outcome is defined as a departure from reference conditions.

The following indicators were considered for each species:

- How habitat quantity, quality, and distribution is affected by management actions.
- The trends in the quantity, quality, and distribution of habitat.
- The trends in distribution and abundance of the species.

The effects from management actions on the indicators are influenced by numerous measures such as the extent of area affected, the severity of impacts, and the duration of impacts. The consequences of the impacts are then related to their effect on trends to suitable habitat and species populations. The ratings and their descriptions are as follows:

- **Low** – Management actions would have low likelihood of changing habitat quantity or distribution in the planning area. Management actions could have low to high levels of ground or vegetation disturbance within the watersheds. However, due to the small area of impacts and with implementation of best management practices (BMPs⁵) there would be minimal impacts to habitat quality. Trends to suitable habitat and species populations would be maintained or improved in the planning area.
- **Moderate** – Management actions would have low likelihood of changing habitat quantity or distribution in the planning area. Management actions could have low to high levels of ground or vegetation disturbance within the watersheds with a larger extent of area impacted. There would be impacts to habitat quality even with implementation of BMPs. However, impacts would be of short duration and would maintain or improve habitat quality in the long term. Trends to suitable habitat and species populations would be maintained or improved within the planning area.
- **High** – Management actions would have moderate to high likelihood of decreasing habitat quantity or distribution in the planning area. Management actions would have high extent, severity, and duration of impacts to the ecosystem. There would be adverse impacts to habitat quantity, quality, and distribution even with implementation of BMPs. The decrease in habitat would reduce species populations within the planning area.

An assessment of species diversity for the Prescott NF was completed as part of the “Prescott National Forest Ecological Sustainability Report” (Forest Service, 2009b). From an initial list of 815 species, 119 were determined to have a potential viability concern. Species viability assessments were prepared according to Forest Service policy (FSM 2670) and documented in three specialist reports (Forest Service, 2011f, 2011g, and 2011h).

Viability risks were based on assessments of:

- Availability and current conditions of the habitat or habitat features with which the species are typically associated.
- Population occurrence and distribution.
- Threats from Forest Service management actions expected to occur within the planning area⁶. The results of these assessments provided a determination of no, low, or some risk to viability for each species evaluated.

⁵ BMPs are a practice or combination of practices determined to be the most effective, practicable means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals, and are developed to comply with the Clean Water Act.

⁶ “Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired nonnative vertebrate species in the planning area. For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area...” 36 CFR § 219.19 (1982).

As part of the plan revision process, coarse filter plan components (i.e., desired habitat conditions statements) were developed that describe the desired outcomes and conditions for terrestrial vegetation, riparian habitats and features, and aquatic habitats and features within the planning area. For species determined to be at no or low risk, meeting and maintaining these desired conditions within the planning area would provide for the viability of those species. For those species determined to be at some risk, additional fine filter plan components (e.g., standards, guidelines, and objectives) were developed to lessen population viability risks to ensure the viability of those species.

Of the 119 species indicating a potential viability concern, there were 55 plant species, 11 mammals, 33 birds, 3 reptiles, 2 amphibians, 12 fish, and 3 invertebrates. Forty-five species were found to have no risk to their viability, 47 species were found to have low risk to their viability; and 27 were found to have some additional risk to their population viability.

Table 22 provides a summary of the species that were assessed to be at some potential viability risk and the corresponding Prescott NF plan components (coarse or fine filter) proposed to ensure that viable populations of species can be maintained in the planning area.

Table 22. Plan components addressing species viability concerns

| Viability Filter Category | Taxon | Associated Plan Components | Species |
|--|-------------------------|---|--|
| Coarse filter plan components alone are sufficient to reduce viability to a level of no or low risk. | Plants | Desired Conditions-Vegetation-1, 3, 4, 5 Desired Conditions-Watershed-1 and 2 Desired Condition-Lands-2 | Tonto Basin agave, Phillips' agave, Mt. Dellenbaugh sandwort, creeping milkvetch, Utah bladder fern, Metcalfe's ticktrefoil, Flagstaff pennyroyal, Senator Mine alum-root, New Mexico alum-root, Oak Creek triteleia, broadleaf lupine |
| | Mammals | PNVT Desired Conditions | Gunnison's prairie dog, plains harvest mouse, western red bat |
| | Birds | Desired Conditions-Watershed-1 and 2 Desired Conditions-Aquatic-1 and 2 Desired Condition-Lands-2 | Gilded flicker, Gila woodpecker, elf owl, Lucy's warbler, purple martin, Grace's warbler, northern goshawk, juniper titmouse, Gray vireo, piñon jay, Virginia's warbler, western burrowing owl, western grasshopper sparrow, southwestern willow flycatcher, western yellow-billed cuckoo, Abert's towhee, bald eagle, common black-hawk, Bell's vireo |
| | Reptiles and Amphibians | | Morafka's desert tortoise, narrow-headed gartersnake, Arizona toad, lowland leopard frog |
| | Fish | | Gila chub, Gila trout, roundtail chub, desert sucker, longfin dace, Sonora sucker, speckled dace |
| | Macroinvertebrates | | Brown springsnail, Verde Rim springsnail, Maricopa tiger beetle |

| Viability Filter Category | Taxon | Associated Plan Components | Species |
|---|-------------------------|---|--|
| Coarse filter plan components (various desired condition statements) plus fine filter plan components are necessary to reduce viability to a level of no or low risk. | Plants | Standard-Plants-1 and 2 Standard-Recreation-1 Standard-Locatable Minerals-2 Guidelines-Plants-1, 2, 3, 5, 6 Guideline-Range-4 Guideline-Recreation-5 Guideline-Locatable Minerals-6 | Arizona wild buckwheat, basin bladderpod, White Mountain bladderpod, Mearns lotus, Macdougal's bluebells, skunk-top scurfpea, Arizona phlox, Rusby's milkwort, Verde Valley sage, black dropseed, southwestern ringstem, Yavapai wild buckwheat, Ripley's wild buckwheat |
| | Mammals | Guidelines-Wildlife-1, 2, 3, 6 Objectives-25 to 28 | Pale Townsend's big-eared bat, pocketed free-tailed bat, pronghorn antelope |
| | Birds | Guideline-Wildlife-1, 2, 4, 5 | American peregrine falcon, Mexican spotted owl, red-faced warbler, cordilleran flycatcher, Bendire's thrasher |
| | Reptiles and Amphibians | Guideline-Fish/Aquatics-1, 2, 3, 4 | Mexican gartersnake |
| | Fish | Standard-Range-2 Guideline-Watershed - 4, 8, and 11 Guideline-Wildland Fire-8 | Gila topminnow, razorback sucker, loach minnow, spikedace, Colorado pikeminnow |

Documents that provide additional details on analysis of species viability:

- Viability Procedures for Use in Forest Plan Revision – Draft (Forest Service, 2010c)
- Ecological Sustainability Report (Forest Service, 2009b)
- Prescott National Forest Plan Revision EIS Terrestrial Species Viability Report (Forest Service, 2011f)
- Prescott National Forest Plan Revision EIS Fisheries Specialist Report and Viability Analysis (Forest Service, 2011g)
- Prescott National Forest Plan Revision EIS Vascular Plant Viability Analysis (Forest Service, 2011h)

Management Indicator Species Selection

The 1982 Planning Rule Provisions (Section 219.19) provide direction for the selection and use of management indicator species (MIS) in Forest Service land management planning. Direction includes the following:

- “In order to estimate the effects of each alternative on fish and wildlife populations, certain vertebrate and/or invertebrate species present in the area shall be identified and

- selected as management indicator species and the reasons for their selection will be stated. These species shall be selected because their population changes are believed to indicate the effects of management activities.” (219.19(1))
- “Planning alternatives shall be stated and evaluated in terms of both amount and quality of habitat and of animal population trends of management indicator species.” (219.19(2))
 - “Population trends of management indicator species will be monitored and relationships to habitat changes determined.” (219.19(6))

Selection Criteria

Forest Service biologists and planners followed the process outlined in the “Region 3 Management Indicator Species Selection Process and Criteria,” working draft (Forest Service, 2010d) to evaluate and select MIS for the proposed revised plan and alternatives. The following criteria were used to guide selection of Prescott NF management indicator species:

- The species reflect major management issues or challenges.
- The species are relatively common but have high fidelity to specific habitat or vegetation types.
- The species demonstrate a strong and/or predictable response to management activities.
- A substantial portion of the species life history occurs on Prescott NF lands.
- The species can be monitored effectively and efficiently and is already monitored by large-scale monitoring programs.
- The species are monitored by other entities (e.g., State wildlife agency census data)
- The species represent the following categories where appropriate:
 - Endangered and threatened plant and animal species identified on State and Federal lists.
 - Species with special habitat requirements that may be influenced substantially by planned management programs.
 - Species commonly hunted, fished, or trapped.
 - Non-game species of special interest.
 - Other plant or animal species whose population changes are believed to be appropriate indicators of the effects of management activities on other species (i.e., proxies).

Management indicator species are vertebrate or invertebrate species whose population changes indicate the effects of management activities included in plan components. Habitats that reflect major management issues or challenges and habitats that could be evaluated using MIS were identified.

Information sources such as the “Forest Level Analysis of Management Indicator Species (MIS) for the Prescott National Forest,” 2009 update (Forest Service, 2010e) and the “Ecological Sustainability Report” (Forest Service, 2009b) were used to identify species that could provide evaluation of management actions in habitats identified previously.

Species were reviewed to determine whether: (1) they were strongly influenced by factors other than management activities or did not have well understood narrow habitat associations, and (2) their known populations trends were not related to local changes in habitat composition, structure, or ecological processes.

Selection of Management Indicator Species

The chosen management indicator species are listed below with narratives describing how criteria for selection were met.

Pronghorn Antelope (*Antilocapra americana*): Game Species

- *Species reflect major management issues or challenges?*
Yes. Grassland PNVTs on the Prescott NF are highly departed relative to reference and desired conditions in terms of species composition, horizontal and vertical structure, and fire patterns. Grassland restoration objectives are proposed in varying amounts for all alternatives.
- *Are relatively common but have high fidelity to specific vegetation types?*
Yes. Pronghorn was selected for its close association to grassland habitats. Grassland habitats occupy more than 270,000 acres of the area administered by the Prescott NF and over 1.6 million acres within the Tonto Transition Ecological Section of central Arizona.
- *Demonstrate a strong and/or predictable response to management activities?*
Yes. Increases in pronghorn population numbers and expansion of pronghorn occurrences on or near Prescott NF lands are goals shared by both the Forest Service and the Arizona Game and Fish Department. The agencies work collaboratively to implement habitat improvement projects on Prescott NF lands. Best available science is applied to project design criteria to facilitate habitat improvements.
- *Substantial portion of the species life history occurs on Prescott NF administered lands?*
Yes. While pronghorn populations can be influenced by predators and weather, habitat loss off the forest is a significant impact to local populations. As areas off the forest become unavailable due to habitat loss or fragmentation from urban development, suitable habitat on the forest will likely become more critical to maintaining a sustainable pronghorn population.
- *Can be monitored effectively and efficiently and is already monitored?*
Yes. Because pronghorn are a MIS under the 1987 forest plan, there are strong baseline data to assess trends from management activities past, present, and future.
- *Are monitored by other entities?*
Yes. Pronghorn are currently monitored by the Arizona Game and Fish Department on an annual basis for areas on and adjacent to the Prescott NF.

Northern goshawk (*Accipiter gentilis*): Forest Service Sensitive Species

- *Species reflect major management issues or challenges?*

Yes. Ponderosa pine dominated forests on the Prescott NF are highly departed relative to reference and desired conditions in terms of species composition, horizontal and vertical structure, and fire patterns. Ponderosa pine restoration objectives are proposed in varying amounts for all alternatives.

- *Are relatively common but have high fidelity to specific vegetation types?*

Yes. Northern goshawk is a forest dwelling raptor chosen for its close association with ponderosa pine habitat (all stages of stand structure). The goshawk's primary prey species, the tassel-eared squirrel, is also closely associated with ponderosa pine vegetation. Ponderosa pine habitat occupies about 112,000 acres of the area administered by the Prescott NF and almost 500,000 acres within the Tonto Transition Ecological Section of central Arizona.

- *Demonstrate a strong and/or predictable response to management activities?*

Yes. Monitoring of proposed restoration activities (e.g. prescribed fire, timber harvest, small diameter tree thinning) would reveal the continued suitability of ponderosa pine forests to provide a mix of seral stages necessary for nesting and foraging for the northern goshawk and associated prey species.

- *Substantial portion of the species life history occurs on Prescott NF administered lands?*

Yes. Considering space requirements for northern goshawks, the landscape on the Prescott NF would have a limited capacity for goshawk territories.

- *Can be monitored effectively and efficiently and is already monitored?*

Yes. Because northern goshawk are a MIS under the 1987 forest plan, there are baseline data to assess trends from management activities past, present, and future.

- *Are monitored by other entities?*

Yes. Northern goshawk is currently monitored on an annual basis by Forest Service and National Park Service units in central and northern Arizona.

Aquatic macroinvertebrates (*various species*): Species with special habitat requirements

- *Species reflect major management issues or challenges?*

Yes. Native fish and other aquatic species are in decline within several watersheds on the Prescott NF. Restoration objectives to provide habitat and watershed characteristics that will support native fish species are proposed in varying amounts for all alternatives.

- *Are relatively common but have high fidelity to specific habitats?*

Yes. Aquatic macroinvertebrates were selected as an indicator of water quality based on their responsiveness to changes in water quality and physical features of stream channels essential for quality habitat. Perennial and perennial-interrupted streams occupy only 1 percent of the area administered by the Prescott NF, but they are critical for both aquatic and terrestrial species viability throughout central Arizona.

- *Demonstrate a strong and/or predictable response to management activities?*

Yes. A warm-water index of biological integrity (IBI) is used for perennial streams below 5,000 feet elevation. The IBI uses metrics to assess community and taxa richness. Best

available science is applied to project design criteria to facilitate warm-water fish habitat improvements.

- *Substantial portion of the species life history occurs on Prescott NF administered lands?*
Yes.

- *Can be monitored effectively and efficiently and is already monitored?*

Yes. Because macroinvertebrates are a MIS under the 1987 forest plan, there are baseline data to assess trends from management activities past, present, and future.

- *Are monitored by other entities?*

Yes. Aquatic macroinvertebrates are currently monitored by the Arizona Department of Environmental Quality on a 5-year rotation basis for each of the major basins in Arizona following established EPA rapid bioassessment protocols.

Documents that provide additional details on the selection of MIS

- Region 3 Management Indicator Species Selection Process and Criteria, Working Draft (Forest Service, 2010d)
- Forest Level Analysis of Management Indicator Species (MIS) for the Prescott National Forest, 2009 update (Forest Service, 2010e)
- Ecological Sustainability Report (Forest Service, 2009b)
- Prescott National Forest Management Indicator Species Selection Process (Forest Service, 2011i)

Recreation Analysis

The recreation analysis was based on professional judgment and in consultation with the Prescott NF plan revision team and recreation program managers.

The trends for maintenance backlog costs were derived from the deferred maintenance reports in the Forest Service Infrastructure corporate database. Although deferred maintenance figures are reported directly for developed recreation, the trails deferred maintenance figures are based on a nationally implemented sampling methodology.

Results from the National Visitor Use Monitoring (NVUM) program were used to develop visitor profiles and use patterns. The NVUM results were obtained using a methodology that has been developed and employed nationally.

The seven visitor segments are defined in NVUM as follows:

- Nonlocal day trips: Nonlocal residents on day trips.
- Nonlocal OVN-NF: Nonlocal residents staying overnight on the national forest.
- Nonlocal OVN: Nonlocal residents staying overnight off the national forest.
- Local day trips: Local residents on day trips.
- Local OVN-NF: Local residents staying overnight on the national forest.
- Local OVN: Local residents staying overnight off the national forest.

The estimated changes in visitation were developed by the Prescott NF plan revision team and recreation program managers based on professional judgment and the following assumptions.

All Alternatives

Nonlocal visitors on day trips are generally assumed to be passing through—they are not from here and the Prescott area/Verde Valley are not their destination. It is assumed that they primarily visit day use developed sites and their duration of stay is under 2 hours. None of the alternatives are focused on increasing short term, day-use opportunities; therefore, it was concluded that visits from this segment would not increase due to the actions in any alternative.

Alternative B

The greatest increase is expected to come from local day users, those people who live in and around the Prescott area, within about 100 miles or a 2-hour drive. This would include day users from both Flagstaff and the Phoenix area. Day users would benefit the most from improved trails and trailheads, enhanced fishing opportunities, and designated dispersed camping. Overnight visitors on the forest would benefit from increased camping opportunities, both developed and dispersed. Overnight off-forest visitors would mainly benefit from the improved trails and trailheads.

Alternative C

The expected increases in use are the same for all segments except for local day users. Their use would not increase as much because trails and trailheads that would receive the improvements would most likely be those that received the greatest use. Lesser used trails that received use primarily from locals would probably see fewer improvements. Visits by overnight off-forest visitors would not be expected to change from alternative B because they would still experience improvements at the popular trails and trailheads.

Alternative D

Local visitors would benefit the most from the greater emphasis on trails and trailheads, including the additional miles of trail that would be constructed to create loops and connect communities. Fewer new developed camping opportunities would be expected to have the biggest impact on nonlocal, overnight, on-forest visitation due to a smaller increase in capacity than alternatives B and C.

Table 23 represents the expected changes in visitation due to changes in recreation management proposed in the action alternatives. No expected changes in visitation were projected for alternative A because it represents the continuation of 1987 forest plan direction and contains no changes in management.

Table 23. Projected change in recreation visitation by alternative

| Visitor Segments | Alt. A | Alt. B | Alt. C | Alt. D |
|------------------|--------|--------|--------|--------|
| Nonlocal day | 0% | 0% | 0% | 0% |
| Nonlocal OVN-NF | 0% | + 5% | + 5% | + 3% |
| Nonlocal OVN | 0% | + 2% | + 2% | + 3% |
| Local day | 0% | + 10% | + 7% | + 12% |
| Local OVN-NF | 0% | + 5% | + 5% | + 7% |
| Local OVN | 0% | + 5% | + 5% | + 5% |

Expected changes in visitation are expressed as a percent change (e.g., +/- 10 percent) from visitation expected under 1987 forest plan direction.

Documents that provide additional details on the recreation analysis:

- National Visitor Use Monitoring Results for the Prescott National Forest (Forest Service, 2009c)
- Prescott National Forest Plan Revision EIS Recreation Specialist Report (Forest Service, 2011o)
- R3 Wilderness Trends in Use (Forest Service, 2009d)
- Prescott National Forest Recreation Niche (Forest Service, 2006)

Scenery and Open Space Analysis

The scenery and open space analysis was based on professional judgment and in consultation with the Prescott NF plan revision team, landscape architect, and lands program manager. This included development of landscape character descriptions and the identification of concern levels for the Scenery Management System.

The Scenery Management System (SMS), a tool developed and deployed nationally by the USDA Forest Service, was used to map, inventory, and assess the current state of the scenic resource on the Prescott NF. It provides a systematic approach for determining the relative value and importance of scenery on national forest lands.

The first step in SMS is to describe the valued landscape character. The landscape character description includes the valued attributes of the landscape, including the important elements of the social environment and environmental regimes, creating a “sense of place.” A description of the biological and physical elements is drawn from data available for ecological or planning units. This landscape character description provides the frame of reference for defining the scenic attractiveness classes.

The landscape character description is also used as a reference for the existing scenic integrity. Existing scenic integrity (ESI) indicates the degree of intactness and wholeness of the landscape character. Conversely, ESI is also a measure of the degree of visible disruption of the landscape character. For example, a landscape with very minimal visual disruption is considered to have a

higher ESI; while landscapes with conflicting scenic attributes are viewed as having a lower ESI. ESI is expressed and mapped in terms of very high, high, moderate, low, very low, and unacceptably low. There were no areas on the Prescott NF determined to have an unacceptably low level of scenic integrity, so the ESI determination contained only the five categories described below.

- **Very High** – A scenic integrity level that generally provides for ecological change only. The landscape character is intact. Examples would include all designated wilderness areas.
- **High** – A scenic integrity level meaning human activities are not visually evident; the landscape character appears intact. In high scenic integrity areas, activities may only repeat attributes of form, line, color, and texture found in the existing landscape character. Examples would include the Black Hills area west of the Verde Valley and areas southeast of Granite Mountain Wilderness.
- **Moderate** – A scenic integrity level meaning human activities must remain visually subordinate to the attributes of the existing landscape character. Activities may repeat form, line, color, or texture common to these landscape characters, but changes in quality of size, number, intensity, direction, pattern, and so on, must remain visually subordinate to these landscape characters. Examples include areas immediately west and south of Prescott along the forest boundary.
- **Low** – A scenic integrity level meaning human activities begin to dominate the attributes of the existing landscape character, but they borrow from naturally established form, line, color, or texture so that its visual characteristics are those of natural occurrences within the surrounding area. Examples include areas on the eastern end of the Santa Maria Mountains along the forest boundary.
- **Very Low** – A scenic integrity level meaning human activities of vegetative and landform alterations may dominate the original, natural landscape character but should appear as natural occurrences when viewed at background distances. Examples include certain areas disturbed by flagstone quarries northeast of Drake.

The next step of the SMS inventory is the mapping of “scenic classes,” which show the relative importance of scenery. Scenic classes are determined from a combination of the uniqueness of lands (called scenic attractiveness) and who is viewing those lands (called landscape visibility). There are seven scenic classes, with one being the highest and seven being the lowest.

Scenic attractiveness is used to determine the relative scenic value of lands within a particular landscape character. The three scenic attractiveness classes are: Class A – distinctive; Class B – typical; and Class C – indistinctive. The landscape elements of landform, vegetation, rocks, cultural features, and water features are considered when determining each of these classes.

Landscape visibility is composed of two parts: human values as they relate to the relative importance to the public of various scenes, and the relative sensitivity of scenes based on distance from an observer. Human values that affect perceptions of landscapes are derived from constituent analysis. Constituent analysis serves as a guide to perceptions of attractiveness, helps identify special places, and helps to define the meaning people give to the landscape. Constituent analysis leads to a determination of the relative importance of aesthetics to the public. This importance is expressed as a concern level. Sites, travelways, special places, and other areas are

assigned a concern level value of 1, 2, or 3 to reflect their relative high, medium, or low importance.

As part of the landscape visibility analysis, seen areas and distance zones are mapped from these concern level areas to determine the relative sensitivity of scenes based on their distance from an observer. These distance zones are identified as:

- **Foreground** – up to 1/2 mile from the observer
- **Middle ground** – 1/2 to 4 miles from the observer
- **Background** – 4 miles from the observer to the horizon

Seldom seen areas not seen from travel routes or identified use points are assigned a concern level 1, 2, or 3, based on concern for a specific area, and they may occur in any distance zone or scenic attractiveness class.

A composite scenery base map was produced in ArcMap showing the existing scenic integrity and scenic classes. This was then used to develop new scenic integrity objectives (SIOs) for the proposed revised forest plan.

The results of the analysis were that just over 8 percent of the forest, primarily the designated wilderness areas, received an ESI rating of “very high.” The majority of the remaining forest land, 83 percent, is naturally appearing and has an ESI of “high.” Only about 7 percent of the forest was considered “moderate”; the “low” and “very low” ratings combined accounted for less than 1 percent of the acreage on the forest.

Documents that provide additional details on the scenery and open space analysis:

- Prescott National Forest Plan Revision EIS Scenery and Open Space Specialist Report (Forest Service, 2011p)
- Prescott National Forest Scenery Management System Inventory Report (Forest Service, 2008b)

Socioeconomic Analysis

Section 219.12(h) of the 1982 Planning Rule directs the planning team to “evaluate the significant physical, biological, economic, and social effects of each management alternative that is considered in detail. The evaluation shall include a comparative analysis of the aggregate effects of the management alternatives and shall compare present net value, social and economic impacts, outputs of goods and services, and overall protection and enhancement of environmental resources.” The economic analysis helps to fulfill these evaluation requirements.

Economic impacts were modeled using IMPLAN Professional Version 3.0 (IMpact analysis for PLANing, Minnesota IMPLAN Group, Inc.) with 2009 data. IMPLAN is an input-output model, which estimates the economic impacts of projects, programs, policies, and economic changes on a region. IMPLAN analyzes the direct, indirect, and induced economic impacts. Direct economic impacts are generated by the activity itself, such as the value of cattle grazed on the forest. Indirect employment and labor income contributions occur when a sector purchases supplies and services from other industries in order to produce their product. Induced contributions are the

employment and labor income generated as a result of spending new household income generated by direct and indirect employment. The employment estimated is defined as any part-time, seasonal, or full-time job. In the economic impact tables, direct, indirect, and induced contributions are included in the estimated impacts. The IMPLAN database describes the economy in 440 sectors using Federal data from 2009.

Data on use levels under each alternative were collected from the forest's resource specialists. In most instances, the precise change is unknown. Therefore, the changes are based on the professional expertise of the forest's resource specialists (1982 Rule, 219.12(g)). Data on current and future forest use levels were entered in The Forest Economic Analysis Spreadsheet, which is an Excel workbook that interfaces with IMPLAN to streamline data entry and generate economic impact tables.

Regional economic impacts of the proposed plan alternatives are estimated based on the assumption of full implementation of each alternative. The actual changes in the economy would depend on individuals taking advantage of the resource related opportunities that would be supported by each alternative. If market conditions or trends in resource use were not conducive to developing some opportunities, the economic impact would be different than estimated here.

Financial efficiency analysis was conducted with QuickSilver Version 6. The financial efficiency analysis compares the anticipated Forest Service expenditures and revenues, by alternative, over the life of the forest plan for each alternative. Data on program expenditures and revenues were provided by the Prescott NF resource specialists and budget staff (1982 Rule, 219.12(e)). A 4 percent discount rate is commonly used for evaluations of long-term investments and operations in land and resource management by the Forest Service (FSM 1971.21). This discount rate was used in the calculation of present net value (PNV).

PNV is the difference between program revenues (benefits) and program expenditures (costs) over a 15-year period, using a 4 percent discount rate. The annual expenditures were summed over 15 years using a 4 percent discount rate (so that one dollar today is valued higher than one dollar in 10 years). The sum of the discounted annual expenditures represents the present value of costs. The same exercise was conducted using the annual program revenues for key resources areas. The sum of the discounted annual revenues represents the present value of benefits. The difference between the present value of costs and the present value of benefits is present net value. The higher the PNV, the more financially efficient the alternative. Inflation can affect PNV; however, due to the uncertainty of future inflation, OMB Circular A-94 recommends avoiding assumptions about the inflation rate whenever possible. Thus, for the purposes of this analysis, inflation is left at zero.

Data on use levels under each alternative were collected from the forest's resource specialists. In most instances, the precise change is unknown. Therefore, the estimated changes were based on the professional expertise of the forest's resource specialists (1982 Rule, 219.12(g)).

Social impacts were estimated using the baseline social conditions presented in the "Socioeconomic Resources Affected Environment" section of the DEIS and visitor profiles from the FY2009 NVUM results for the Prescott NF (Forest Service, 2009c) to discern the primary values that the forest provides to area residents and visitors. Social effects were based on interaction of the identified values with estimated changes to resource availability and uses.

The socioeconomic impacts analyses included these additional assumptions:

- Information on the timing of costs and benefits was not available for the economic efficiency analysis. Furthermore, the analysis does not provide a full accounting of all costs and benefits. The only benefits considered are program revenues (i.e., forest receipts). The only costs considered are direct forest expenditures. Therefore, the following estimates of net present value are limited to the available data, which was sufficient to conduct a thorough economic efficiency analysis.
- The economic impact of grazing was estimated using authorized levels. However, actual use is permitted annually based on various factors, such as current forage conditions. Therefore, the estimated economic impact of grazing is likely to overstate the jobs and income provided.
- Changes in use levels were estimated using professional judgment. However, actual changes in use are difficult to predict and frequently depend on factors outside the control of the Forest Service.
- Some of the value of forest management is not captured in market transactions. Nonmarket goods and services, such as clean air and scenic vistas, have economic values. However, the monetary value of such goods and services is generally unknown. As a result, it is difficult to analyze potential tradeoffs between market and nonmarket values. In general, management actions that promote forest health will increase nonmarket values. For the purpose of this analysis, recommended wilderness areas will be used as a proxy for nonmarket values.
- The framework for the social analysis employs generalities. Area residents and Prescott NF visitors have diverse preferences and values that may not be fully captured in the description of social consequences. Nevertheless, the general categories are useful for assessing social impacts based on particular forest related interests.

Documents that provide additional details on the socioeconomic analysis:

- Socio-economic Resource Report (Forest Service, 20011q)
- National Visitor Use Monitoring Results for the Prescott National Forest (Forest Service, 2009c)

References

- ESSA Technologies Ltd. (2006). <http://www.essa.com/downloads/vddt/index.htm>
- Forest Service, U.S. Department of Agriculture. (1981). *Verde River Wild and Scenic River Study Report and Environmental Impact Statement*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (1997). *Environmental Assessment for Grapevine Springs Botanical Area Designation*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2006). *Prescott National Forest Recreation Niche*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2008a) *Ecological Sustainability Analysis of the Prescott National Forest: An Evaluation of Water Resource Characteristics, and their*

- Contribution in Ecological Diversity and Ecological Sustainability*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2008b). *Prescott National Forest Scenery Management System Inventory Report*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2009a). *Research Natural Area Process for Forest Plan Revision under the 1982 Planning Rule Provisions*. Albuquerque, NM: Southwestern Region Regional Office.
- Forest Service, U.S. Department of Agriculture. (2009b). *Ecological Sustainability Report*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2009c). *National Visitor Use Monitoring Results for the Prescott National Forest*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2009d). *R3 Wilderness Trends in Use*. Albuquerque, NM: Southwestern Region Regional Office.
- Forest Service, U.S. Department of Agriculture. (2010a). *Prescott National Forest Research Natural Area Evaluation Process Summary Report*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2010b). *Upper Verde River Eligibility Report Update for the National Wild and Scenic River System*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2010c). *Viability Procedures for Use in Forest Plan Revision – Draft February 2, 2010*. Albuquerque, NM: Southwestern Region Regional Office.
- Forest Service, U.S. Department of Agriculture. (2010d). *Region 3 Management Indicator Species Selection Process and Criteria, modified from R2 – Working Draft Edited by R3-February 2, 2010*. Albuquerque, NM: Southwestern Region Regional Office.
- Forest Service, U.S. Department of Agriculture. (2010e). *Forest Level Analysis of Management Indicator Species (MIS) for the Prescott National Forest, 2009 update*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2011a). *Prescott National Forest Potential Wilderness Area Evaluation Report*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2011b). *Wilderness Recommendations by Forest Plan Alternative*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2011c). *PNF Recreation Suitability Matrix*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2011d). *Prescott National Forest Determination of Livestock Grazing Capability and Suitability Report*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2011e). *Prescott National Forest Timber Suitability, Long-term Sustained Yield Capacity, and Allowable Sale Quantity Report*. Prescott, AZ: Prescott National Forest.

- Forest Service, U.S. Department of Agriculture. (2011f). *Prescott National Forest Plan Revision EIS Terrestrial Species Viability Report*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2011g). *Prescott National Forest Plan Revision EIS Fisheries Specialist Report and Viability Analysis*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2011h). *Prescott National Forest Plan Revision EIS Vascular Plant Viability Analysis*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2011i). *Prescott National Forest Management Indicator Species Selection Process*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2011j). *Prescott National Forest Vegetation and Fire Ecology Specialist Report*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2011k). *Prescott National Forest Plan Revision EIS Hydrology and Soils Specialist Report*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2011m). *Watershed Condition Classification Technical Guide. FS-978*. Washington, DC: Stream Systems Technology Center.
<http://www.fs.fed.us/publications/watershed/>
- Forest Service, U.S. Department of Agriculture. (2011n). USDA Forest Service Watershed Condition Classification Dataset. Accessed November 2011
<http://www.fs.fed.us/publications/watershed/interactivemap/USDAFS-WCF-2010.html>
- Forest Service, U.S. Department of Agriculture. (2011o). *Prescott National Forest Plan Revision EIS Recreation Specialist Report*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2011p). *Prescott National Forest Plan Revision EIS Scenery and Open Space Specialist Report*. Prescott, AZ: Prescott National Forest.
- Forest Service, U.S. Department of Agriculture. (2011q). *Socio-economic Resource Report*. Prescott, AZ: Prescott National Forest
- Girard, M.M., Robbie, W.A., and Wahlberg, M. (2008). *Ecological Classification of the Prescott National Forest*. Albuquerque, NM: Forest Service Southwestern Region Regional Office
- LANDFIRE. (2007). LANDFIRE National Vegetation Dynamics Models. Accessed April 2008.
<http://www.landfire.gov/index.php>
- Lauenroth, W.K., and Laycock, W.A. (1989). *Secondary succession and the evaluation of rangeland condition*. Westview Press, Inc., Boulder, CO. pp. 163
- Mellin, T.C., Triepke, F.J., and Joria, P.E. (2008). Mapping existing vegetation at the mid-scale level in the Forest Service Southwestern Region. in *Proceedings of the Twelfth Biennial USDA-Forest Service Remote Sensing Applications Conference (RS-2008), 15-17 April 2008, Salt Lake City, UT*. Washington, DC: Forest Service Remote Sensing Applications Center.
- Rebain, Stephanie A. (comp.) (2010) (revised 2012). *The fire and fuels extension to the forest vegetation simulator: updated model documentation. Internal Report* (revised March 20, 2012). USDA Forest Service. Forest Management Service Center, Fort Collins, CO. pp. 397.

- Robertson, G. Boness, P., Gallegos, J., Hurja, J., Leathy, S., Miller, G., Robbie, W., Scalzone, K., Stein, R., and Steinke, R. (2000). Terrestrial Ecosystem Survey of the Prescott National Forest. Forest Service, Southwestern Region. Albuquerque, NM.
- Schussman, H., and Smith, E. (2006). Vegetation models for Southwest Vegetation. Prepared for the USDA Forest Service, Southwestern Region by The Nature Conservancy, Tucson, AZ. Pp. 11.
- Weisz, R., Triepke, J., Vandendriesche, D., Manthei, M., Youtz, J.A., Simon, J., and Robbie, W. (2010). Evaluating the ecological sustainability of a piñon-juniper grassland ecosystem in Northern Arizona. in Jain, T.B., Graham, R.T., and Sanquist, J. tech eds. *Integrated management of carbon sequestration and biomass utilization opportunities in a changing climate: Proceedings of the 2009 National Silviculture Workshop; 2009 June 15-18; Boise, ID. Proceedings RMRS-P-61*. Fort Collins, CO: Rocky Mountain Research Station.
- Weisz, R., Vandendriesche, D., Moeur, M., Boehning, M., Wadleigh, L., Triepke, J., White, M., Nelson, C., Palmer, J., Youtz, J., Higgins, B., Nicolet, T., Bostwick, P., Mindar, D., Pitts, J., Manthei, M., and Robbie, W. (2012). *White Paper O: process overview of using FVS to create VDDT models*. USDA Forest Service, Southwestern Region, Interoffice Publication, Albuquerque, NM.
- Youtz, J.A., and Vandendriesche, D. (2011). *National Forest Planning and Sustained Yield of the Timber Resource Long-term Sustained-Yield Calculations for Forest Land and Resource Management Planning*. Albuquerque, NM: Forest Service Southwestern Region Regional Office

